Food and Agriculture Organization of the United Nations

WORLD BANK GROUP

State and Peacebuilding Fund

Norwegian Ministry of Foreign Affairs

Assessment of Forest Resource Degradation and Intervention Options in Refugee-Hosting Areas of Western and Southwestern Uganda

February 2020

SHOUT
SHARE
IT

Assessment of Forest Resource Degradation and Intervention Options in Refugee-Hosting Areas of Western and Southwestern Uganda

February 2020

ENV

© 2020 The World Bank and the Food and Agriculture Organization of the United Nations
1818 H Street NW, Washington DC 20433 / Viale delle Terme di Caracalla 00153 Rome, Italy
Telephone: 202-473-1000; Internet: www.worldbank.org / E-mail: FO-Publications@fao.org;
Internet: www.fao.org

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of The World Bank or The Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area, or of its authorities. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank or FAO concerning the endorsement or acceptance of such boundaries. The World Bank and FAO do not guarantee the accuracy of the data included in this work.

The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by The World Bank and FAO in preference to others of a similar nature that are not mentioned. The findings, interpretations and conclusions expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of The World Bank, World Bank Board of Executive directors, the FAO, or the governments and members represented by these institutions.

Rights and Permissions

The World Bank and FAO encourage the use, reproduction and dissemination of material in this information product. Except where otherwise indicated, material may be copied, downloaded and printed for private study, research and teaching purposes, or for use in non-commercial products or services, provided that appropriate acknowledgement of The World Bank and FAO as source and copyright holders is given.

Attribution—Please cite the work as follows: “World Bank and FAO. 2020. Assessment of Forest Resource Degradation and Intervention Options in Refugee-Hosting Areas of Western and Southwestern Uganda. © World Bank and FAO.”

All queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.

Cover photo: © Matthew Owen

TABLE OF CONTENTS

LIST OF FIGURES II

LIST OF TABLES III

ACKNOWLEDGMENTS IV

ACRONYMS V

EXECUTIVE SUMMARY VI

1 INTRODUCTION 1

- 1.1 Background 1
- 1.2 Objectives and approach 2
- 1.3 Area of interest 2
- 1.4 Refugee and host community policy framework 3
- 1.5 Refugee institutional framework 5
- 1.6 Regulatory and policy framework for the forest sector 5
- 1.7 Institutional responsibilities for the forest sector 7
- 1.8 Regulatory and policy framework of the biomass energy sector 8

2 SOCIOECONOMIC FINDINGS 9

- 2.1 Population and household characteristics 9
- 2.2 Fuel consumption for cooking 13
- 2.3 Access to firewood 14
- 2.4 Cooking stove ownership 16
- 2.5 Cookstove disadvantages.... 18
- 2.6 Challenges associated with energy access for cooking 21

3 TREE COVER, LAND USE/LAND COVER AND WOODY BIOMASS RESOURCES FINDINGS....22

- 3.1 Kyaka II settlement 22
- 3.2 Kyangwali settlement.... 25
- 3.3 Rwamwanja settlement 31
- 3.4 Kiryandongo settlement 34
- 3.5 Nakivale and Oruchinga settlements 37

4 LINKING WOODFUEL DEMAND AND POTENTIAL SUPPLY....40

5 RECOMMENDED TECHNICAL INTERVENTIONS....43

- 5.1 Development of agroforestry systems 44
- 5.2 Establishment of private woodlots for energy and other purposes 45
- 5.3 Restoration and conservation of natural forests in protected areas 48
- 5.4 Rehabilitation and conservation of natural forests on private and communal land 51
- 5.5 Upgrading of cooking systems and energy value chains 53

6 CONCLUSIONS 56

7 BIBLIOGRAPHY 58

ANNEX 1: METHODOLOGIES 60

ANNEX 2: POTENTIAL LAND SUITABLE FOR THE RECOMMENDED INTERVENTIONS 66

ANNEX 3: ANNUAL RAINFALL IN THE AOIS 71

ANNEX 4: AREAS OF POTENTIAL TECHNICAL INTERVENTIONS (IN HA) WITHIN 15 KM BY SOIL TYPE AND RAINFALL 73

ANNEX 5: ANNUAL TREE COVER LOSS FROM 2001 TO 2018 75

LIST OF FIGURES

Figure 1. Location of the target refugee settlements and the 5 km and 15 km buffers 3
Figure 2. Refugee respondents by country of origin 9
Figure 3. Household categorization according to primary livelihood (percentage) 11
Figure 4. Sources of household income (percentage) 12
Figure 5. Market in Kyaka II refugee settlement 12
Figure 6. Sources of firewood (percentage) 14
Figure 7. Categorization of firewood collectors among refugee and host communities (percentage) 15
Figure 8. Typical charcoal stoves 16
Figure 9. Common three-stone fire arrangements 17
Figure 10. Typical mud stoves 17
Figure 11. Household cooking systems (percentage) 18
Figure 12. Cookstove preferences (percentage) 20
Figure 13. Dual-fuel mud stove 21
Figure 14. Kyaka II refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018) 23
Figure 15. Tree cover loss within LULC transition classes in Kyaka II 15 km buffer (2001–2018) 23
Figure 16. Biomass stock in Kyaka II settlement and 5 km and 15 km buffers (2017) 25
Figure 17. Biomass stock changes in Kyaka II settlement and 5 km and 15 km buffers (2000–2017) 25
Figure 18. Kyangwali refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018) 26
Figure 19. Tree cover loss within LULC transition classes in Kyangwali 15 km buffer (2001–2018) 26
Figure 20. Biomass stock in Kyangwali settlement and 5 km and 15 km buffers (2017) 28
Figure 21. Biomass stock changes in Kyangwali settlement and 5 km and 15 km buffers (2000–2017) 28
Figure 22. Refugee households at the edge of Bugoma CFR, with charcoal production activities and tree cover loss.. 29
Figure 23. Rwamwanja refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018) 31
Figure 24. Tree cover loss within LULC transition classes in Rwamwanja 15 km buffer (2001–2018) 31
Figure 25. Biomass stock in Rwamwanja settlement and 5 km and 15 km buffers (2017) 33
Figure 26. Biomass stock changes in Rwamwanja settlement and 5 km and 15 km buffers (2000–2017) 33
Figure 27. Kiryandongo refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018) 34
Figure 28. Tree cover loss within LULC transition classes in Kiryandongo 15 km buffer (2001–2018) 34
Figure 29. Biomass stock in Kiryandongo settlement and 5 km and 15 km buffers (2017) 36
Figure 30. Biomass stock changes in Kiryandongo settlement and 5 km and 15 km buffers (2000–2017) 37
Figure 31. Nakivale and Oruchinga refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018) 38
Figure 32. Tree cover loss within LULC transition classes in Nakivale and Oruchinga 15 km buffer (2001–2018) 38
Figure 33. Biomass stock in Nakivale and Oruchinga settlements and 5 km and 15 km buffers (2017) 40
Figure 34. Biomass stock changes in Nakivale and Oruchinga settlements and 5 km and 15 km buffers (2000-2017) 40
Figure 35. Summary of tree cover loss from across buffers in the AoIs (2001-2018) 42
Figure 36. Summary of AGB stock changes across buffers in the AoIs (2000-2017) 42
Figure 37. Agroecological zones........ 44
Figure 38. Potential land suitable for technical interventions in Kyaka II AoI 67
Figure 39. Potential land suitable for technical interventions in Kyangwali AoI 68
Figure 40. Potential land suitable for technical interventions in Rwamwanja AoI 69
Figure 41. Potential land suitable for technical interventions in Kiryandongo AoI 70
Figure 42. Potential land suitable for technical interventions in Nakivale-Oruchinga AoI 71
Figure 43. Annual tree cover loss from 2001 to 2018 in Kyaka II 77
Figure 44. Annual tree cover loss from 2001 to 2018 in Kyangwali 78
Figure 45. Annual tree cover loss from 2000 to 2018 in Rwamwanja 79
Figure 46. Annual tree cover loss from 2001 to 2018 in Kiryandongo 80
Figure 47. Annual tree cover loss from 2001 to 2018 in Nakivale 81
Figure 48. Annual tree cover loss from 2001 to 2018 in Oruchinga 82

LIST OF TABLES

Table 1. Profile of the refugee settlements and extent of AoIs ... 2
Table 2. Key government entities involved in forestry initiatives ... 6
Table 3. Gender of survey respondents (percentage) ... 9
Table 4. Average household size of respondents ... 10
Table 5. Percentage of male-headed households ... 10
Table 6. Refugee and host community fuel consumption ... 13
Table 7. Frequency of firewood collection per household (percentage) ... 15
Table 8. Disadvantages of using the three-stone fire (percentage) ... 18
Table 9. Disadvantages of using one-pot mud stove (percentage) ... 19
Table 10. Sources of cookstoves (percentage) ... 20
Table 11. Changes in LULC and biomass stock in Kyaka II 5 km buffer (2000-2017) ... 24
Table 12. Changes in LULC and biomass stock in Kyaka II 15 km buffer (2000-2017) ... 24
Table 13. Changes in LULC and biomass stock in Kyangwali 5 km buffer (2000-2017) ... 27
Table 14. Changes in LULC and biomass stock in Kyangwali 15 km buffer (2000-2017) ... 27
Table 15. Changes in LULC and biomass stock in Rwamwanja 5 km buffer (2000-2017) ... 32
Table 16. Changes in LULC and biomass stock in Rwamwanja 15 km buffer (2000-2017) ... 32
Table 17. Changes in LULC and biomass stock in Kiryandongo 5 km buffer (2000-2017) ... 35
Table 18. Changes in LULC and biomass stock in Kiryandongo 15 km buffer (2000-2017) ... 35
Table 19. Changes in LULC and biomass stock in Nakivale and Oruchinga 5 km buffer (2000-2017) ... 39
Table 20. Changes in LULC and biomass stock in Nakivale and Oruchinga 15 km buffer (2000-2017) ... 39
Table 21. Estimated woodfuel demand and potential supply within target refugee settlements and 5 km buffer .. 41
Table 22. Indicative costs of agroforestry intervention, per-hectare basis ... 46
Table 23. Potential areas suitable for establishment of woodlots within 15 km buffer zone ... 47
Table 24. Potential areas suitable for establishment of woodlots or rehabilitation of degraded woodlands within 15 km buffer zone ... 48
Table 25. Woodfuel plantation establishment and maintenance costs ... 48
Table 26. Woodlot requirements for energy ... 48
Table 27. Potential areas for restoration of natural forests in protected areas ... 49
Table 28. Conservation of intact natural forests in protected areas within 15 km buffer ... 49
Table 29. Indicative costs for conservation of natural forests in protected areas, per-hectare basis over five years ... 50
Table 30. Indicative costs for assisted natural regeneration and protection of natural forests in protected areas, per-hectare basis over five years ... 51
Table 31. Potential areas for rehabilitation of degraded natural forests on private and communal land within 15 km buffer ... 53
Table 32. Potential areas for conservation of intact natural forests on private and communal land within 15 km buffer ... 54
Table 33. Indicative costs for rehabilitation and protection of natural forests in communal and private land, per-hectare basis over five years ... 54
Table 34. Indicative costs for cooking energy enhancements ... 55
Table 35. Average cooking fuel cost comparison ... 56
Table 36. Harmonization of classes of the LULC map and AGB stock data ... 63
Table 37. Annual increment (air-dry matter), as national averages ... 64
Table 38. Specifications applied for mapping technical intervention areas ... 65
Table 39. AGB stock with margin of error ... 66

ACKNOWLEDGMENTS

Between February and July 2019, the World Bank commissioned the Food and Agriculture Organization of the United Nations (FAO) to undertake an 'Assessment of Forest Resource Degradation and Intervention Options in Refugee-Hosting Areas of Western and Southwestern Uganda'. This was an extension of a similar assessment undertaken in 2018 in the West Nile region. The aim was to determine the environmental impacts of the refugee influx, with a focus on forest resources, and propose intervention options to mitigate pressure on the environment and support energy access for both refugee and host communities.

This Technical Report was prepared by the following authors at FAO: Arturo Gianvenuti, Rashed Jalal, and Joseph Kirule. The report benefitted considerably from inputs by the following colleagues: Alberto Bigi, Kathryn Clark, Cindy Côté-Andreetti, Laura D'Aietti, Marcello D'Orazio, Yelena Finegold, Priya Gujadhur, Leonidas Hitimana, Orjan Jonsoon, Walter Mapanda, Emmanuella Olesambu, Chiara Patriarca, Antonio Querido, Ewald Rametsteiner, Stefano Ricci, Antonello Salis, Simona Sorrenti, Rebecca Tavani, Lauri Vesa, Sven Walter, and Zuzhang Xia.

The World Bank task team comprised Ross Hughes (Task Team Leader), Lesya Verheijen (Senior Operations Consultant), Herbert Oule (Senior Environmental Specialist), Zewditu Halie (Forced Displacement Consultant), and Matthew Owen (Biomass Consultant).

The team received expert advice from peer reviewers Ranya Sheriff (UNHCR) and Varalakshmi Vemuru (World Bank).

The report was produced under the overall guidance of Antony Thompson (Country Manager, Uganda) and Iain Shuker (Practice Manager, SAFE2).

The authors also wish to acknowledge and thank those in Uganda who provided invaluable assistance with the field work and the review of this study: the National Forestry Authority; the Office of the Prime Minister; the District Local Governments of Hoima, Kikuube, and Kyegegwa; the country offices of the World Food Program and the United Nations High Commissioner for Refugees (UNHCR); the UNHCR Sub-office in Hoima, Field Office in Kyangwali, and Field Unit in Kyaka II; and the field teams of the Lutheran World Federation at Kyangwali and the Danish Refugee Council at Kyaka II.

This report was made possible through financing by the Government of Norway through the State and Peacebuilding Fund (SPF), a global fund to finance critical development operations and analysis in situations of fragility, conflict, and violence. The SPF is kindly supported by Australia, Denmark, Germany, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the International Bank for Reconstruction and Development.

ACRONYMS

AGB	Above-ground Biomass
AoI	Area of Interest
CFM	Collaborative Forest Management
CFR	Central Forest Reserve
CRRF	Comprehensive Refugee Response Framework
DFS	District Forestry Services
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
FMP	Forest Management Plan
FSSD	Forestry Sector Support Department
GCR	Global Compact on Refugees
GoU	Government of Uganda
IBEK	Improved Basic Earth Kiln
LFR	Local Forest Reserve
LPG	Liquefied Petroleum Gas
LULC	Land Use and Land Cover
MEMD	Ministry of Energy and Mineral Development
MWE	Ministry of Water and Environment
NASA	National Aeronautics and Space Administration
NBS	National Biomass Study
NDP	National Development Plan
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NFI	National Forest Inventory
NGO	Non-governmental Organization
NP	National Park
NWFP	Non-wood Forest Products
OPM	Office of the Prime Minister
pppd	per person per day
ReHOPE	Refugee and Host Population Empowerment
RIMA	Resilience Index Measurement and Analysis
SPF	State and Peacebuilding Fund
SPGS	Sawlog Production Grant Scheme
t	metric ton
THF	Tropical High Forest Well Stocked
THFL	Tropical High Forest Low Stocked
TM	Thematic Mapper
UBOS	Uganda Bureau of Statistics
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
USGS	United States Geological Survey
UWA	Uganda Wildlife Authority
WFP	World Food Program
WorkGrEEn	Working Group on Energy and Environment
WR	Wildlife Reserve

EXECUTIVE SUMMARY

Ongoing regional instability has led to the forced displacement of more than 1.3 million refugees and asylum-seekers to Uganda (as of October 2019), mostly from South Sudan, the Democratic Republic of the Congo, Burundi, and Somalia, making Uganda the largest refugee host country in Africa. This has resulted in the establishment or reopening of some of the world's largest refugee settlements. The displacement has often been accompanied by environmental impacts, such as land degradation and forest depletion, and risk of competition with host communities over the use of natural resources.

Uganda's forest resources play a key role, not only in sustaining significant biodiversity and providing essential ecosystem services, but also in supporting livelihoods, meeting the country's high demand for energy in the form of firewood and charcoal, and enhancing resilience and adaptation capacity. Forest resources in refugee-hosting areas are at risk of exacerbated pressure on the environment, adding to existing pressures from high rates of agricultural expansion linked to population growth, underlying poverty, and limited resilience to climate shocks.

Given the large number of refugees who have received asylum in Uganda, and the diverse nature of their impacts on both the natural and social capital of the hosting districts, there is a need to develop comprehensive interventions for sustainable energy access and forest resource management, targeting both refugees and hosts. As part of a durable system of sustainable land management, well-planned forestry interventions, including afforestation, reforestation, and restoration, can ensure the long-term supply of woodfuel, timber, building materials, and other forest products, minimizing detrimental environmental impacts and facilitating sustainable development.

Uganda's policy environment is supportive of improving the management of natural resources, and this presents an opportunity to address current barriers and enhance the resilience of people and their livelihoods, particularly where major resource degradation is occurring.

Building on a 2018 assessment of natural resource degradation in the refugee-hosting areas of northwestern Uganda, the World Bank commissioned the Food and Agriculture Organization of the United Nations (FAO) to undertake a follow-on assessment of forest resource degradation in refugee-hosting areas in the west and southwest of the country[1], and to identify potential intervention options to mitigate pressure on forest resources, enhance sustainable woodfuel supply and contribute to resilience-building of both the displaced and host communities.

The area of interest (AoI) for the assessment was the 'buffer zone'[2] up to 5 km from the boundaries of the six settlements: Kyaka II, Kyangwali, Rwamwanja, Kiryandongo, Nakivale and Oruchinga. A wider AoI up to 15 km from the settlement boundaries was also assessed to understand dynamics within host communities. The assessment took place in May 2019 and used a combination of remote sensing around all six settlements, together with household survey at Kyaka II (Kyegegwa District) and Kyangwali (Kikuube District). In total, 688 refugee and host community households were surveyed.

The findings of both studies add to the evidence base for the World Bank/Government of Uganda (GoU) '*Investing in Forests and Protected Areas for Climate-smart Development*' project. The findings may also guide other development partners' support for programming energy and environment interventions.

Main findings

The assessment revealed the following key findings:

- Both **host and refugee households rely almost entirely on woodfuel to meet their energy needs.** Firewood is dominant at Kyangwali settlement, where it is the primary fuel for 75.5 percent of households, while charcoal dominates at Kyaka II (where it is the main fuel for 77.5 percent of households). A similar but less pronounced pattern is seen among host community households, with firewood dominant in the villages around Kyangwali (being the main fuel for 92.5 percent of households) and less so around Kyaka II (78.7 of host households).

---

[1] World Bank Contractual Agreement no. 7190640; FAO Project Symbol: OSRO/UGA/902/WBK

[2] 5 km encompasses the area within reasonable walking distance most likely to serve as a woodfuel source.

- **Refugee households using firewood as their primary fuel use less on average than host community households** where firewood is the main fuel, within both the surveyed settlements. Similarly, **refugee households using charcoal as their main fuel use less charcoal on average than host community households** where charcoal is the main fuel, also in both locations. As a greater proportion of refugee households use charcoal as their main fuel**,** however, **total average consumption is higher for refugees than hosts when converted to 'firewood-equivalent'**: average woodfuel consumption in firewood-equivalent is 2.6 kg per person per day (pppd) among refugees at Kyaka II and 2.8 kg pppd at Kyangwali, compared with 2.3 kg pppd and 2.6 kg pppd, respectively, for host community households around the same settlements. Construction, commercial activities and agricultural activities (which were not considered) contribute further to total wood demand. In addition, uncontrolled fires can cause significant biomass losses.
- **The sourcing of firewood is a cause of mild tension between refugees and host communities** where they find themselves competing for the same resource. The majority of refugee and host communities do not report security threats while sourcing fuel, though in isolated cases individuals have been threatened by personnel guarding forest reserves.
- The primary cooking system for the vast majority of host community households (76.2 percent) is the three-stone open fire. **Within the refugee settlements, a greater diversity of cooking devices exists**. The largest proportion of refugees at Kyaka II (41.5 percent) use improved charcoal stoves. At Kyangwali, the three-stone fire dominates (43.6 percent of households), followed by mud stoves in one-pot and two-pot versions (34.3 percent and 23.8 percent, respectively).
- Users **associate the three-stone fire with high smoke emissions**, which are perceived to cause health problems, while **mud stoves reportedly break easily**, **cook slowly, get damaged by rain**, **and do not hold the pot firmly** during stirring. The majority of refugee and host community members obtain their stoves from the market or self-produce them.
- **Total estimated woodfuel consumption is 475,130 metric tons (t) per year** for the combined population of refugees and host communities within 5 km of the four refugee settlements in the west (362,369 refugees [59%] and 252,262 Ugandans [41%])**.** The estimated above-ground biomass (AGB) stock within the same area is 2,521,426 t, with an annual increment of 194,039 t. Assuming that woodfuel demand is met only with biomass from within 5 km, there is therefore an annual deficit equivalent to 11 percent of AGB stock.
- **However, the results of the analysis of tree cover loss and land use and land cover (LULC) changes do not always reflect the losses of AGB that would be expected from woodfuel demand** by refugee and host communities living up to 5 km from the settlement boundaries. That is, an annual loss equivalent to 11 percent of AGB stock is not borne out by remote sensing measurements. This could be due to partial supply of fuel from further away, and potentially by absenteeism among both refugees and hosts. These complexities require site-specific analysis.
- At Kyaka II, Kyangwali, and Nakivale-Oruchinga, tree cover loss was more concentrated in the 5 km buffer than the 15 km buffer, with the reverse being the case at Kiryandongo and Rwamwanja, suggesting **no consistent link between the refugee settlements and patterns of tree cover loss.** In Kyaka II and Kyangwali, tree cover loss was relatively low at 10-13 percent between 2001 and 2018, in both the 5 km and 15 km buffer zones. The lowest percentage tree cover loss was in the Nakivale-Oruchinga AoI, where the presence of trees was already comparatively low.
- The highest loss of biomass between 2000 and 2017 occurred within 15 km of the Kyaka II boundary (1.2 million t), followed by Kyangwali (0.7 million t). Within the 5 km buffer, biomass loss was also highest at Kyaka II (271,000 t) and Kyangwali (223,000 t). **The temporal pattern of tree cover loss around the settlements does not seem related to refugee population changes.**
- Humanitarian guidelines state that **refugee settlements should be located at least at one day's walking distance from protected areas or reserves**, which is not the case with Kyangwali,

Rwamwanja and Kiryandongo settlements, situated near Bugoma Central Forest Reserve, Katonga Wildlife Reserve and Kibeka Central Forest Reserve, respectively. The location of refugee settlements next to protected areas is not in line with Uganda's conservation priorities or the global planning guidelines of the United Nations High Commissioner for Refugees (UNHCR).

- The **main drivers of forest degradation and deforestation** in the settlement buffer areas are the expansion of commercial and subsistence farming; the harvesting of forest products, mainly for charcoal, firewood, and timber; and the expansion of settlements. These drivers often occur concurrently and are mutually reinforcing.
- While refugee and host communities derive livelihoods from a variety of income-generating activities, **the vast majority are involved in farming for food production and sale.** Host community members are more likely to engage in farming for income-generation than refugees. Both communities are engaged in small businesses (e.g., groceries, tailoring, motorbike taxis, alcohol brewing, casual farm labor, and the sale of firewood and charcoal).
- An **integrated response involving stakeholders from different sectors** is required. The assessment recommends several costed interventions to address the ongoing loss and conversion of forest land by supporting more sustainable environmental management, ensuring energy access for cooking, and contributing to building livelihood resilience in both refugee and host communities:
  - **Development of agroforestry systems** where trees and woody perennials are interplanted along boundaries and with crops for energy, food, and fodder. This intervention aims to establish mixed use species on a demand-driven basis, with a particular emphasis on woody-stemmed crops that generate fuel and food, and enhance soil fertility.
  - **Establishment of private woodlots for energy and other purposes.** Demand-driven support for the establishment of woodlots on private land to produce timber, poles, building materials, and fuel that will also provide an income stream to landowners.
  - **Restoration and conservation of natural forests in protected areas,** targeting degraded natural forests in Wildlife Reserves and Central Forest Reserves through restoration activities, alongside conservation of intact forests through protective measures.
  - **Rehabilitation and conservation of natural forests on private and communal land,** comprising rehabilitation, conservation, and institutional support targeting forest and woodlands owned by communities and individuals, applying the community forest provisions of the National Forestry and Tree Planting Act. This also requires the development of Community Forest Regulations.
  - **Upgrading of cooking systems and energy value chains** by supporting the enhancement of energy efficiency through training in fuel-saving practices; promotion of cleaner, faster, and more efficient cooking systems; and improvements to charcoal production methods. Enhancing energy access could potentially improve the situation of women by improving household resilience to socioeconomic and natural shocks.

The estimated 5-year costs of the proposed interventions are summarized below:

Recommended intervention	Estimated 5-yr cost (US$)
Development of agroforestry systems	$565 per ha
Establishment of private woodlots for energy and other purposes	$1,685 per ha
Restoration and conservation of natural forests in protected areas	$337–531 per ha
Rehabilitation and conservation of natural forests on private & communal land	$531 per ha
Upgrading of cooking systems and energy value chains	$25 per household $4,700 per charcoal unit

1. INTRODUCTION

1.1 Background

As of October 2019, more than 1.3 million refugees and asylum-seekers were forcibly displaced to Uganda, mostly from South Sudan, the Democratic Republic of the Congo, Burundi, and Somalia, making Uganda the largest refugee host country in Africa. Existing development challenges in hosting areas in the west of the country have been intensified, notably those affecting the environment, resulting in reduced access to woodfuel for cooking and competition with host communities over the use of limited natural resources (World Bank and FAO 2019). The impacts of refugees may exacerbate existing pressure on forest resources.

Uganda's forest resources play a key role in sustaining biodiversity and strengthening the provision of essential ecosystem services, while also increasing resilience and adaptation capacity, and supporting livelihoods (for example by providing the country's main sources of energy for cooking in the form of firewood and charcoal).

Uganda's rate of forest loss is one of the highest in the world at 4 percent per year. The expansion of commercial and subsistence agricultural land uses are among the main pressures on forest land. Low productivity (due to the limited adoption of improved agricultural practices and technologies), combined with weakly regulated extraction of forest resources for timber, construction materials, and fuel, creates a number of challenges for mitigating environmental impacts.

Woodfuels[3] are the main cooking fuel for more than 90 percent of households in Uganda (UBOS 2018_a) and an even higher proportion of refugees (according to the findings of this study). The sustainable management of the forest resources from which these fuels are derived is essential for the well-being of Ugandans and refugees alike.

Planning and achieving sustainable forest and land management in refugee-hosting areas is crucial to avoid detrimental environmental impacts and facilitate sustainable development for both the displaced populations and host communities. Negative impacts on sensitive natural assets can be partly avoided by adhering to planning guidelines regarding the siting of refugee settlements at least one day's walk from protected areas.[4] Once settlements are established, land use plans are needed that incorporate well-planned forestry interventions, including afforestation, reforestation, and restoration, as vital safety nets and life-supporting assets that can ensure a sustainable supply of woodfuel, timber, building materials, and other forest products for both groups. When sustainably managed, forests and trees act as buffers that help communities withstand extreme weather and other shocks (FAO and UNHCR 2018).

As a follow-up to a 2018 assessment of natural resource degradation in the refugee-hosting areas of northern Uganda (World Bank and FAO 2019), the World Bank commissioned the Food and Agriculture Organization of the United Nations (FAO) to undertake this 'Extended Assessment of Forest Resource Degradation and Practical Intervention Options in Refugee-Hosting Areas in Uganda'[5], targeting the settlements in the west and southwest The findings of both studies will add to the evidence base for the World Bank/Government of Uganda (GoU) investment package '*Investing in Forests and Protected Areas for Climate-smart Development* project', to be supported under the Refugee Sub-Window of the International Development Association's 18th and 19th funding rounds. It is envisaged that the study findings will also guide the support of different development partners for programming energy and environment interventions in the forced displacement context.

---

[3] For this study, 'woodfuels' include firewood and charcoal. 'Firewood' is equivalent to 'fuelwood'.

[4] emergency.unhcr.org/entry/45581/camp-planning-standards-planned-settlements#4,1573456778446

[5] World Bank Contractual Agreement no. 7190640; FAO Project Symbol: OSRO/UGA/902/WBK

1.2 Objectives and approach

The purpose of the assessment was to provide data on forest resource degradation around the six refugee settlements in western and southwestern Uganda: Kiryandongo, Kyaka II, Kyangwali, Nakivale, Oruchinga, and Rwamwanja (Figure 1) and to identify potential intervention options to mitigate pressure on the environment, enhance sustainable woodfuel supply, protect existing natural resources, and contribute to building the resilience of both displaced and host communities.

The study entailed desk review, field survey, and remote sensing analysis. The field survey comprised an in-depth socioeconomic investigation and woodfuel consumption assessment in two of the refugee settlements (Kyangwali and Kyaka II) and nearby villages, as well as field visits to preidentified areas of high tree loss close to those settlements, to collect ground-truth data and understand the main drivers of land cover change.

The assessment builds on the methodology developed in the joint FAO-United Nations High Commissioner for Refugees (UNHCR) technical handbook, 'Assessing Woodfuel Supply and Demand in Displacement Settings'.[6] The methodology comprised three components: (1) assessment of woodfuel demand and associated challenges; (2) assessment of woodfuel supply, including above-ground biomass (AGB) stock and land cover classification and changes; and (3) identification of interventions to address issues related to energy access, natural resource degradation, and livelihoods. The methodology for the socioeconomic survey and remote sensing analysis is described in detail in Annex 1. All fuel consumption estimates were aggregated using the October 2019 refugee population statistics for the target settlements.

1.3 Area of interest

The primary area of interest (AoI) for the assessment was the 'buffer zone'[7] up to 5 km from the boundaries of the six targeted settlements, this being the assumed limit for routine firewood collection. A wider AoI up to 15 km away was also assessed to understand trends and dynamics within host communities The AoIs also include the area occupied by the settlements themselves. Table 1 lists the six settlements with districts, establishment dates, and areas and populations of the 5 and 15 km buffer zones. Figure 1 shows the settlement locations and extent of the buffer zones.

Table 1. Profile of the refugee settlements and extent of AoIs

	Settlement	District	Establishment date	Population		Area of buffer zone (ha)	
				Refugees (Oct 2019)	Hosts (up to 5 km)	up to 5 km	up to 15 km
1	Kyaka II	Kyegegwa	2005	113,023	61,004	30,931	126,500
2	Kyangwali	Kikuube	1960	115,488	90,308	41,950	149,895
3	Rwamwanja	Kamwenge	1964; closed 1995; reopened 2012	70,493	48,000	33,767	132,290
4	Kiryandongo	Kiryandongo	1990; closed 1996; reopened 2014	63,365	52,950	27,255	120,136
5	Nakivale[a]	Isingiro	1960	127,889	173,112	96,844	238,725
6	Oruchinga[a]	Isingiro	1961	7,593		15,774	72,408
				497,851	***425,374***		

Source: Host population: WorldPop 2019 (based on UBOS data).

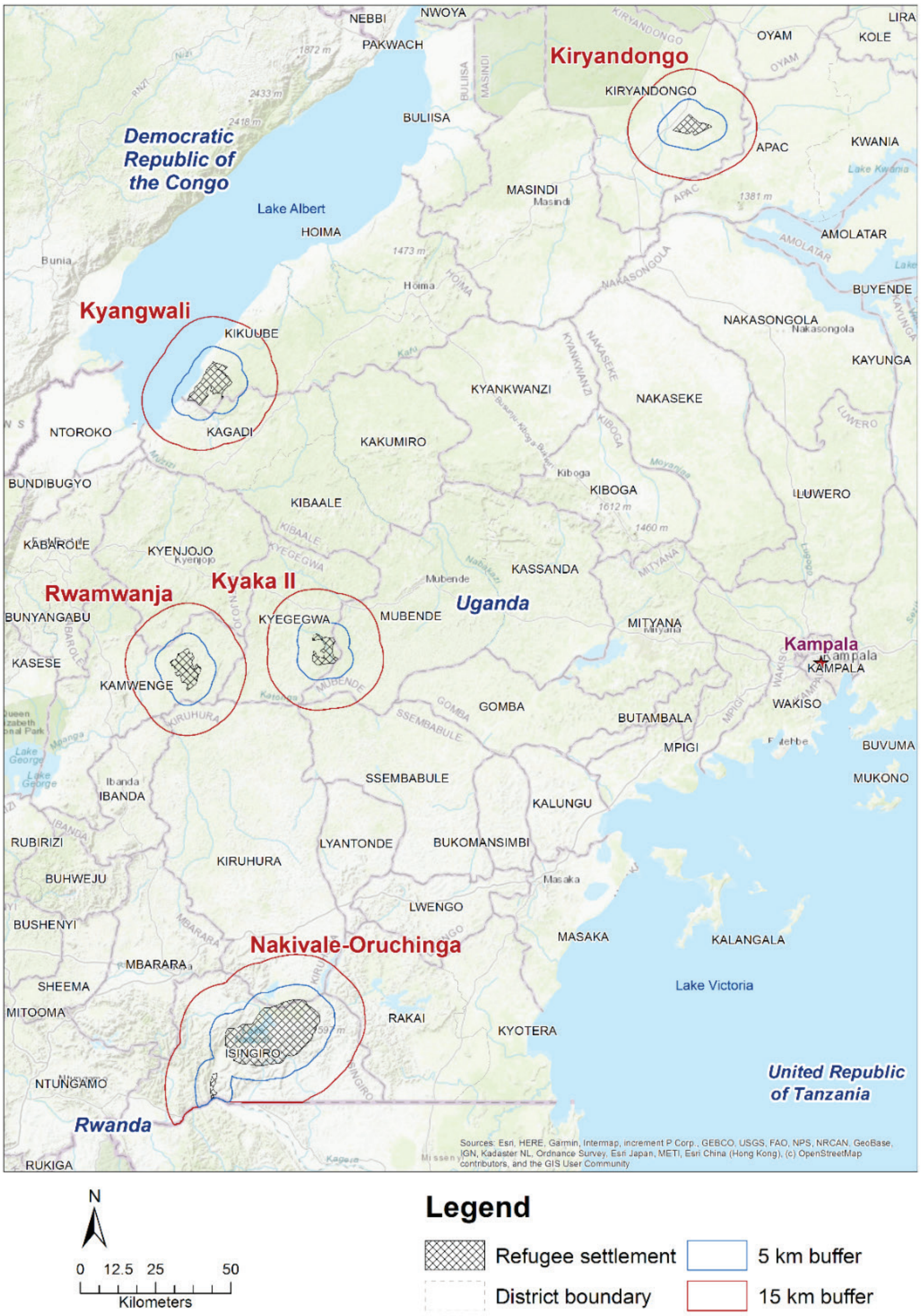
Note: a. The buffers around Nakivale and Oruchinga overlap and are merged in the analysis (with combined areas of 111,023 ha and 258,181 ha for the 5 km and 15 km buffers, respectively).

---

[6] www.fao.org/3/a-i5762e.pdf

[7] www.supermap.com/en/online/deskprodotnet/Features/Analyst/Vector/bufferanalyst/HowBufferWork.htm

Figure 1. Location of the target refugee settlements and the 5 km and 15 km buffers


Kiryandongo
Kyangwali
Rwamwanja
Kyaka II
Nakivale-Oruchinga
Kampala
Uganda
Democratic Republic of the Congo
Rwanda
United Republic of Tanzania
Lake Albert
Lake Victoria
NEBBI
NWOYA
PAKWACH
LIRA
OYAM
KOLE
BULIISA
KIRYANDONGO
APAC
KWANIA
MASINDI
HOIMA
AMOLATAR
BUYENDE
NAKASONGOLA
KAYUNGA
KIKUUBE
KAGADI
NTOROKO
KYANKWANZI
NAKASEKE
KAKUMIRO
BUNDIBUGYO
KIBAALE
KIBOGA
LUWERO
KABAROLE
KYENJOJO
KASSANDA
KYEGEGWA
MUBENDE
MITYANA
BUNYANGABU
KASESE
KAMWENGE
KAMPALA
GOMBA
BUTAMBALA
WAKISO
MPIGI
BUVUMA
MUKONO
SSEMBABULE
IBANDA
KALUNGU
RUBIRIZI
LYANTONDE
BUKOMANSIMBI
KIRUHURA
BUHWEJU
LWENGO
BUSHENYI
MASAKA
KALANGALA
MBARARA
SHEEMA
MITOOMA
RAKAI
KYOTERA
ISINGIRO
NTUNGAMO
RUKIGA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
N
0
12.5
25
50
Kilometers
Legend
Refugee settlement
5 km buffer
District boundary
15 km buffer

Sources: District boundaries: UBOS 2018b; base map: Arc Online; refugee settlement: UNHCR.

1.4 Refugee and host community policy framework

The policy framework for refugee protection in Uganda is multi-tiered, comprising international conventions and declarations, regional agreements, and national regulations and legislation. Uganda's policy toward refugees is among the most progressive in Africa. In accordance with the Refugee Act (2006) and Refugee Regulations (2010), the GoU has developed national frameworks, with an inclusive approach, that grant refugees freedom of movement and the right to work, establish business, and access public services on par with nationals. The Second National Development Plan (NDP-II) (2015/16–2019/20) provides for refugee management and protection as a priority in development planning and implementation by the Office of the Prime Minister (OPM) with the Settlement Transformative Agenda to promote socioeconomic development in refugee-hosting areas. Host districts are required to develop Integrated District Development Plans that incorporate the development needs of refugees alongside those of host communities. The allocation of plots of land where refugees can live and farm has significant implications for the planning of community-based environmental interventions and for intervening to address environmental degradation.[8]

The Refugee and Host Population Empowerment (ReHOPE) is a policy framework launched in 2017 by the GoU in collaboration with United Nations (UN) agencies and the World Bank. It aims to enhance resilience and self-reliance among refugees and host communities. The ReHOPE document strategically guides all interventions in support of refugees and host communities with agencies called upon to demonstrate how they contribute to its realization in a coordinated and complementary manner building on each other's comparative advantage. Furthermore, ReHoPE supports the GoU in addressing environmental degradation in refugee-hosting areas through improved natural resource management and energy access. The ReHoPE approach and its trademark '30–70 principle' guides that a minimum of 30 percent of all refugee-related spending should target host community needs, with many humanitarian organizations aiming for a more equitable split if resources allow. ReHoPE represents a key building block of a comprehensive response to displacement in Uganda and is a critical component in the application of the Comprehensive Refugee Response Framework (CRRF).

Uganda reinforced its progressive refugee and asylum-seeker management model through the operationalization of the New York Declaration for Refugees and Migrants (2016).[9] It is the first country to pilot, and thus embark on, the domestication of the CRRF as a key annex to the New York Declaration and whose implementation directly contributes to forging the Global Compact on Refugees (GCR).[10] The CRRF forms the bedrock for the development of strategies aimed at the realization of the country's mandate to protect and elaborate the rights of refugees entering its borders, along with their hosting communities.

Uganda's national CRRF[11] was launched by the OPM and UNHCR in March 2017 and is guided by the participation of a wide range of stakeholders. The CRRF is structured around five pillars that cover support to refugees, host communities, the government, and the countries of origin: (1) Admission and Rights, (2) Emergency Response and Ongoing Needs, (3) Resilience and Self-reliance, (4) Expanded Solutions, and (5) Voluntary Repatriation (UNHCR 2017).

The 2019–2020 Uganda Refugee Response Plan, launched in February 2019 by the OPM and UNHCR, contributes to achieving the CRRF in Uganda, alongside interventions carried out by government institutions (OPM-UNHCR 2019). The Refugee Response Plan is the guiding inter-agency framework for all partners in the refugee response, where Environmental Protection and Restoration is identified as one of six priority outcome areas. It includes the following Environment and Energy objectives:

1. Environment and natural resources protected and restored, and green livelihoods promoted using a catchment-based approach;
2. Access to sufficient and sustainable basic energy services for lighting, power, and cooking increased and carbon emissions abated; and
3. Energy, environment, and climate action programming and coordination strengthened and mainstreamed across all sectors.

---

[8] documents.worldbank.org/curated/en/259711469593058429/An-assessment-of-Ugandas-progressive-approach-to-refugee-management

[9] The New York Declaration expresses the political will of world leaders to save lives, protect rights, and share responsibility on a global scale. It contains bold commitments to address issues currently faced and to prepare the world for future challenges, as well as concrete plans for how to build on these commitments.

[10] The Global Compact on Refugees (GCR) is a framework for more predictable and equitable responsibility sharing, recognizing that a sustainable solution to refugee situations cannot be achieved without international cooperation. It provides a blueprint for governments, international organizations, and other stakeholders to ensure that host communities get the support they need and that refugees may lead productive lives.

[11] opm.go.ug/comprehensive-refugee-response-framework-uganda

1.5 Refugee institutional framework

The OPM leads the mobilization and coordination of national strategic and political resources, while operational support for implementing the refugee response and protection activities is co-led by the OPM and UNHCR, supported by other UN agencies and partners.

A CRRF Secretariat supports the application of the CRRF; serves as a knowledge hub and platform for strategic discussions; supports coordinated planning, programming, and resourcing to roll out the CRRF Roadmap, which has included the development of the Water and Environment Response Plan and the Jobs and Livelihoods Response Plan; and ensures cross-pillar information flow and links.

In October 2017, a government-led multi-stakeholder CRRF Steering Group was set up, bringing together humanitarian and development actors, government agencies, and refugee and private sector representatives, to engage and provide guidance on refugee affairs. The Steering Group, cochaired by the Ministry of Disaster Preparedness and Refugees in the OPM and the Ministry of Local Government, ensures government ownership of the CRRF and optimizes coordination both at the central and local levels within the existing legal frameworks. Stakeholders of the CRRF in Uganda include UN agencies and non-governmental organizations (NGOs), working closely with the GoU in practical application. UN agencies support the broader humanitarian-development nexus needs of the refugee response, recognizing their collective responsibility in leaving no one behind in achieving the Sustainable Development Goals. In addition to the UN, bilateral partners and international financial institutions (in particular the World Bank) are actively supporting the implementation of the CRRF through humanitarian and development channels.

A Working Group on Energy and Environment (WorkGrEEn) has been constituted under the OPM and UNHCR-led Refugee Coordination Model with representation of actors in the environment and energy sectors (such as government agencies, NGOs, development partners and UN agencies). The WorkGrEEn is co-chaired by the OPM and UNHCR, and its mandate is to support technical oversight, monitoring, reporting and coordination of over 40 actors active in the sector across the refugee response. The National Forestry Authority (NFA), with oversight from the Forest Sector Support Department, also joined the refugee response in 2019 in partnership with OPM and UNHCR. To date, NFA has undertaken restoration in three Central Forest Reserves (CFRs) including new bamboo plantations as well as scale-up of its Community Tree Planting Program to increase availability of indigenous, fast-growing and fruit trees seedlings to refugee-hosting communities.

1.6 Regulatory and policy framework for the forest sector

Uganda has a well-developed legal and regulatory framework for environmental management stemming from the National Environment Management Policy (2019), which aims to promote sustainable economic and social development. The Uganda Forest Policy (2001) provides overall direction for the sustainable development of the forest sector[12]. The following laws and plans specifically relate to forest resource management.

The National Forestry and Tree Planting Act (2003)[13] is the primary law governing forestry in Uganda. The Act provides for the conservation, sustainable management, and development of forests, and also established the NFA. It defines forest reserves and specifies what action can and cannot be carried out within them. The Act commits the government to protect and sustainably manage the forest estate, set aside areas for conservation of biodiversity and environmental services, provide for the sustainable use of forest resources and the enhancement of the productive capacity of forests, provide for the promotion of tree planting, and consolidate laws relating to the forest sector and trade in forest products. In particular, the Act grants power to the Minister (after due consultation and upon approval of the District Council) to declare an area to be a community forest.[14] The law further allows the Minister to specify a responsible local body of residents for the management of such a community forest. However, this provision in the Act for a localized forest management mechanism is not yet backed up by a suitable regulatory framework. Noteworthy is the existence of a framework named Collaborative Forest Management[15] (CFM) with a strong backing under the Act, from which lessons can be drawn for community forests.

---

[12] https://landportal.org/library/resources/lex-faoc144357/uganda-forestry-policy-2001

[13] www.ulii.org/system/files/legislation/act/2003/2003/national%20forestry%20and%20tree%20planting%20Act%202003.pdf

The National Forestry Plan 2011/12–2021/22 sets out the following strategic objectives for the forestry sector: (a) raise incomes for households through forest-based initiatives, (b) increase economic productivity and employment in forest industries, and (c) restore and improve ecosystem services derived from sustainably managed forest resources. The plan's goal of "an integrated forest sector that achieves sustainable increases in economic, social and environmental benefits from forests and trees by all the people of Uganda, especially the poor and vulnerable" is a driving force in itself toward sustainable management.

The Uganda National REDD+ Strategy and Action Plan (2017) identifies eight strategic options16 to support sustainable management of forests, including with the aim of reducing greenhouse gas emissions from deforestation and forest degradation.

The National Environment Act (2019), among others, provides for the management of the environment for sustainable development; confirms NEMA's role as a coordinating, monitoring, regulatory, and supervisory body for all activities relating to the environment; provides for emerging environmental issues including climate change.

1.7 Institutional responsibilities for the forest sector

Table 2 presents the government entities in forest sector management in the target refugee settlements and their environs, and their specific areas of operation and activities.

Table 2. Key government entities involved in forestry initiatives

Institution	Key roles/relevant area of intervention
Ministry of Water and Environment (MWE)	The MWE has overall responsibility for the development, management, and regulation of environmental resources. On forestry matters, the ministry exercises its mandate through the Forestry Sector Support Department (FSSD) under the Directorate of Environmental Affairs, which works in close collaboration with other institutions, such as the NFA, the District Forestry Services (DFS), UN agencies, NGOs, and the private sector in implementing projects and programs. Specific roles of the MWE in the forestry sector include ● Formulation and oversight of policies, standards, and legislation; ● Coordination and supervision of technical support and training to local governments; ● Inspection and monitoring of local government and NFA performance in forestry sector development; ● Coordination of the implementation of the National Forestry Plan and cross-sectoral links; ● Mobilization of funds and other resources for the forestry sector; and ● Promotion, public information, and advocacy for the forestry sector.

---

[14] "An area declared by the Minister responsible for forestry under section 17 of the National Forestry and Tree Planting Act (2003) after consultation with the District Land Board and the local community and upon approval by resolution of the District Council as community forest". It has a Responsible Body for its management, maintenance, and control. Areas that can be registered as community forests may include former public land held by the District Land Board, land designated as 'fragile ecosystem' by the National Environment Management Authority, areas to be planted as community-managed plantations, and woodland/pastoral areas communally used by a community (MWE 2015). Qualified applicants for community forest status may be a forest-adjacent community or a group of forest-adjacent communities, a forest user group, a Communal Land Association, a Cooperative Society, a Farmers' Group, or an NGO that draws its membership from the local community.

[15] A mutually beneficial arrangement in which a forest user group and a Responsible Body share roles, responsibilities, rights, and returns (benefits) in a forest reserve or part of it.

[16] https://www.mwe.go.ug/sites/default/files/library/Final%20-%20Uganda%20REDD%2B%20Strategy%20and%20Action%20Plan-October%202017.pdf

Institution	Key roles/relevant area of intervention
NFA	The NFA has a mandate to manage 506 Central Forest Reserves (CFRs), with the multiple objectives of improving management, expanding partnerships, and supplying forest and non-forest products and services. The NFA mandates include delegations from the MWE, such as activities outside CFRs. Specifically, the NFA is mandated to • Manage all CFRs to provide quality forestry products and services to the people of Uganda, in partnership with the private sector and local communities; • Develop innovative approaches for local community participation in the management of CFRs; • Provide advisory, research, and commercial services on contract; • Provide high-quality seeds and other planting materials to the sector through the National Tree Seed Centre; • Prepare and implement management plans for, and report on the state of, CFRs; and • Provide GIS services for the forestry sector, maintain National Forest Monitoring System.
OPM	The OPM, through its Department for Refugees, is mandated to receive and provide protection to refugees and improve the physical infrastructure within refugee settlements, as well as enhance refugee livelihoods through provision of income-generating activities. Relevant OPM activities include • Highlighting the numbers of refugee arrivals and securing budgets to provide the necessary protection and services; • Carrying out awareness-raising activities, with partners, on the protection of natural resources in refugee settlements; and • Allocating land in refugee settlements.
Uganda Wildlife Authority (UWA)	The UWA is mandated to conserve and manage Uganda's wildlife estate, including 10 National Parks (NPs), 12 Wildlife Reserves (WRs), 5 Community Wildlife Management Areas, and 13 Wildlife Sanctuaries. It also has a role in managing the tourism industry and attracting investors to the sector. Some CFRs are under a co-management arrangement between the UWA and NFA (Budongo, Maramagambo, Morungole, and Zulia CFRs).
District local governments	District local governments have the mandate to • Establish a DFS division; • Strengthen forestry in production and environment committees and District Development Plans; • Issue permits and licenses and collect fees and tax; • Mobilize funds for forestry development; • Develop and enforce bylaws relating to forestry; • Support forestry extension, broker between farmers and service providers, and provide market information; • Manage Local Forest Reserves (LFRs) with communities and private investors; • Generate revenue for forest management and governance; and • Carry out land administration, surveying, and approval of community forests. The roles of the DFS under local government include • Advising the District Council on all matters relating to forestry; • Liaising with the NFA and other lead agencies on matters relating to forestry; • Promoting forestry awareness in the district; • Promoting tree planting; • Managing LFRs; • Advising and supporting the management of community forests; and • Assisting in the development and provision of advisory services relating to private forests.

1.8 Regulatory and policy framework of the biomass energy sector

The institutional set-up within the energy sector has so far given relatively low priority to biomass, compared with petroleum and electricity, despite its overwhelming dominance in national energy supply. A lack of financial and human resources also limits GoU capacity to implement aspirational targets for managing supply and demand for biomass energy. The policy environment is nevertheless supportive of improving the management of natural resources in Uganda and this presents an opportunity to address current barriers and enhance the resilience of people and their livelihoods, particularly where major resource degradation is occurring.

The National Energy Policy Review (2019)[17] of the Ministry of Energy and Mineral Development (MEMD) seeks to meet the energy needs of the Ugandan population by providing adequate and reliable energy supply for socio-economic growth and sustainable development. The revised Energy Policy supersedes the Energy Policy 2002 and aims to align the policy framework with recent international, regional and national developments and commitments, as well as to address the new and emerging socio-economic challenges of the energy sector. The revised Energy Policy covers the following sub-sectors: Renewable Energy, Clean Cooking, Electrical Power, Rural Electrification and Access, Energy Efficiency and Conservation, Nuclear Energy and selected cross cutting issues. The Renewable Energy Policy (2007) aims to increase the use of modern renewable energy. A key policy objective for the bioenergy sector is the efficient use of biomass for energy to contribute to the management of resources in a sustainable manner.

The Biomass Energy Strategy for Uganda (2013)[18] aims to promote practical approaches for managing the biomass energy sector in Uganda and addresses (a) policy and regulatory issues, (b) supply management interventions, (c) demand management interventions, and (d) cross-cutting issues. The strategy has targets for biomass energy efficiency, sustainable supply, and substitution, though the MEMD and the MWE have lacked the resources to enact many of its proposals.

---

[17] http://www.energyandminerals.go.ug/site/assets/files/1081/draft_revised_energy_policy_-_11_10_2019-1_1.pdf

[18] www.undp.org/content/dam/uganda/docs/UNDPUg2014%20-%20Biomass%20BEST%20Strategy(compressed).pdf

2. SOCIOECONOMIC FINDINGS

2.1 Population and household characteristics

2.1.1 Sample size

The socioeconomic survey was carried out in two of the six refugee settlements in May 2019 and covered 688 households[19], of which roughly half (55 percent) were refugee households. About 26.6 percent of the surveyed households were in Kyangwali settlement (Kikuube District) and 29.1 percent in Kyaka II settlement (Kyegegwa District). The remainder were in six host villages: Hanga 2A, Rwengabi, and Wairagaza in Kikuube District (27.2 percent) and Bujuburi West, Kyakakwanzi, and Nyakatooke in Kyegegwa District (17.2 percent). Details on the survey methodology are provided in Annex 1.

2.1.2 Gender and nationality

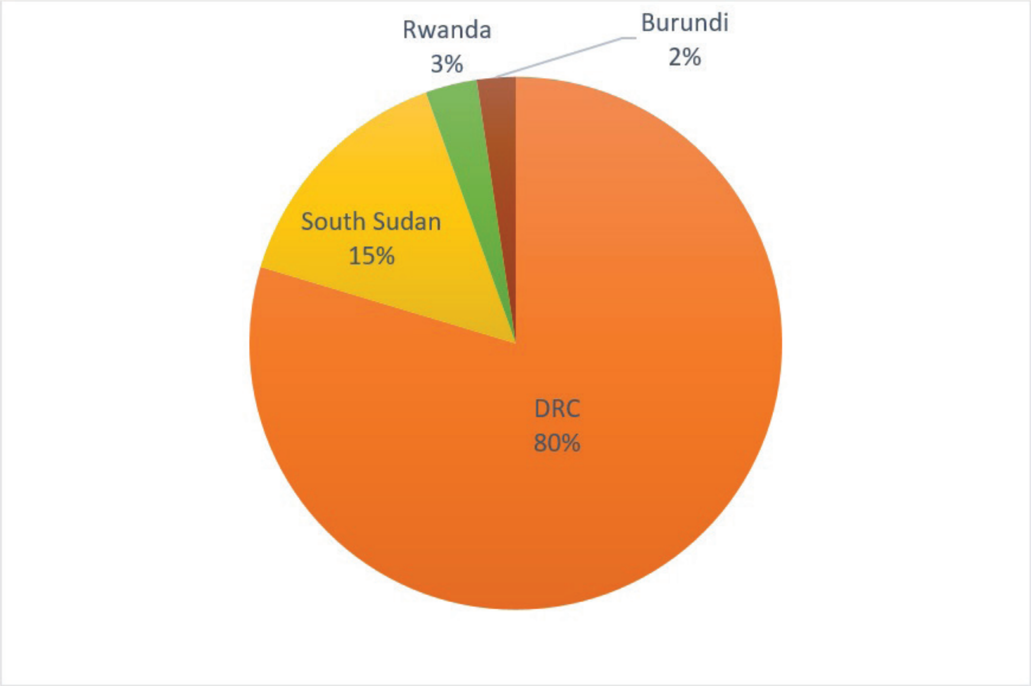
A large majority of survey respondents (69.3 percent) were female, with a higher proportion in the refugee settlements (73.4 percent) than in the host communities (64.3 percent) (Table 3).

Table 3. Gender of survey respondents (percentage)

Community type	Kyangwali		Kyaka II		Overall average	
	Male	Female	Male	Female	Female	Male
Refugee settlement	23.0	77	30	70	73.4	26.6
Host community	40.1	59.9	28.8	71.2	64.3	35.7

As summarized in Figure 2, 80 percent of the interviewed refugees were from the Democratic Republic of the Congo, 15 percent from South Sudan, and the remainder from Rwanda and Burundi. The mean age of interviewees was 36 years.

Figure 2. Refugee respondents by country of origin



---

[19] This sample size takes into account a two-stage sample selection with an overall error of maximum 0.05 with a confidence level of 95% (see Annex 1).

2.1.3 Size of households

The average household size in the surveyed refugee settlements was 5.9 persons, with Kyangwali reporting slightly more members (6.1) than Kyaka II (5.7), both with a wide range of 11 persons between the smallest and largest household. These figures are higher than the national average household size of four persons for refugees in Uganda (UNHCR 2019). The average household was slightly lower (5.8) in the host communities (Table 4).

Table 4. Average household size of respondents

Location		**Mean household size**
Refugee settlements	Kyangwali	6.1
	Kyaka II	5.7
Average (settlements)		*5.9*
Host communities	Kyangwali	5.8
	Kyaka II	5.9
Average (host communities)		*5.8*

About 70 percent of the surveyed households were male-headed (Table 5), with the percentage higher among the host communities (82.4 percent and 74.4 percent for Kyangwali and Kyaka II host communities, respectively) than in the refugee settlements (61.7 percent and 64.5 percent for Kyangwali and Kyaka II settlements, respectively).

Table 5. Percentage of male-headed households

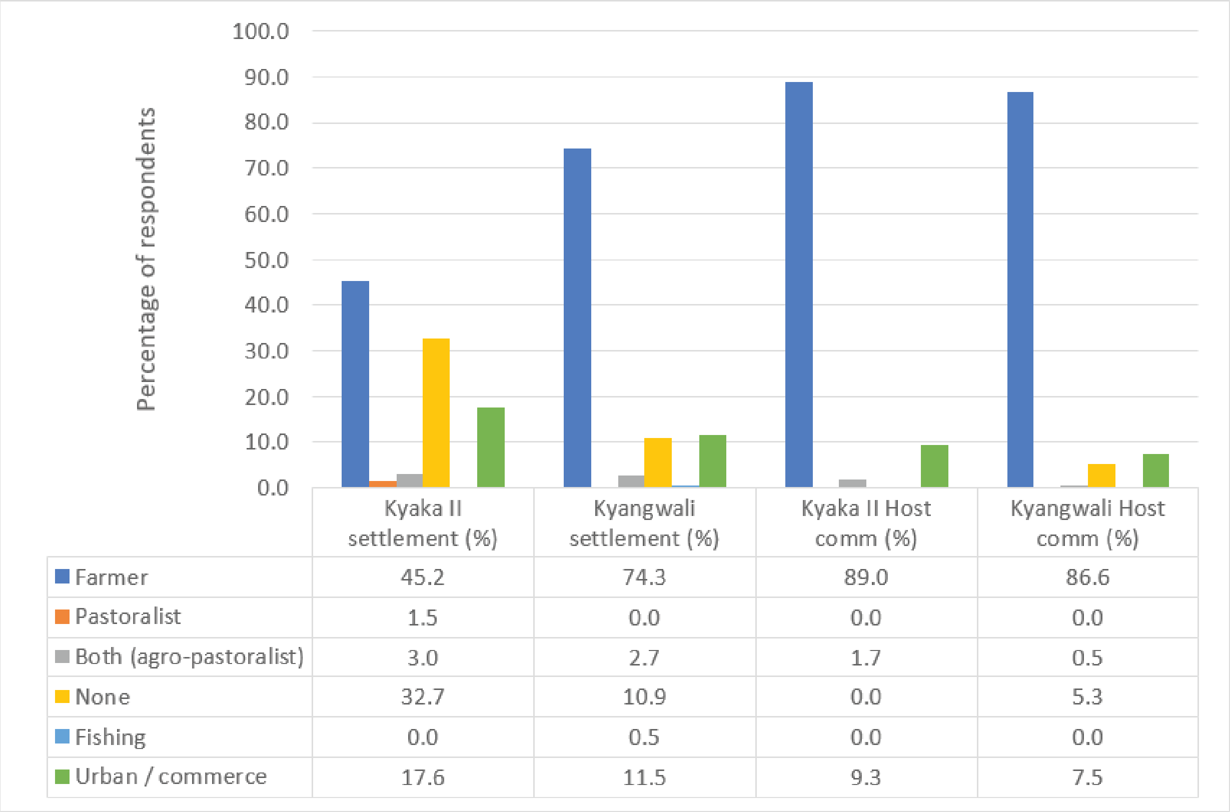
Refugees		**Hosts**		**Average**
Kyangwali	**Kyaka II**	**Kyangwali**	**Kyaka II**	
61.7	64.5	82.4	74.4	70.7

2.1.4 Livelihood background

Farming is the dominant livelihood activity among both refugee settlements and host communities, supporting a greater proportion of households in the host communities (86.6 percent and 89 percent in Kyangwali and Kyaka II, respectively) than in the refugee settlements (74.3 percent and 45.2 percent in Kyangwali and Kyaka, respectively) (Figure 3). This can probably be attributed to land limitations facing refugee households.

A significant number of refugee households in Kyangwali (11 percent) and Kyaka II (32.7 percent) did not identify with any livelihood category, usually because they were recent arrivals fully reliant on humanitarian assistance. Overall, a higher proportion of refugee households were found to engage in urban commercial activities such as small grocery shops, tailoring, or woodfuel selling (17.6 percent in Kyangwali and 11.5 percent in Kyaka II) than those from the host community (7.5 percent and 9.3 percent in Kyangwali and Kyaka II, respectively).

Figure 3. Household categorization according to primary livelihood (percentage)



	Kyaka II settlement (%)	Kyangwali settlement (%)	Kyaka II Host comm (%)	Kyangwali Host comm (%)
🟦 Farmer	45.2	74.3	89.0	86.6
🟧 Pastoralist	1.5	0.0	0.0	0.0
⬜ Both (agro-pastoralist)	3.0	2.7	1.7	0.5
🟨 None	32.7	10.9	0.0	5.3
🟦 Fishing	0.0	0.5	0.0	0.0
🟩 Urban / commerce	17.6	11.5	9.3	7.5

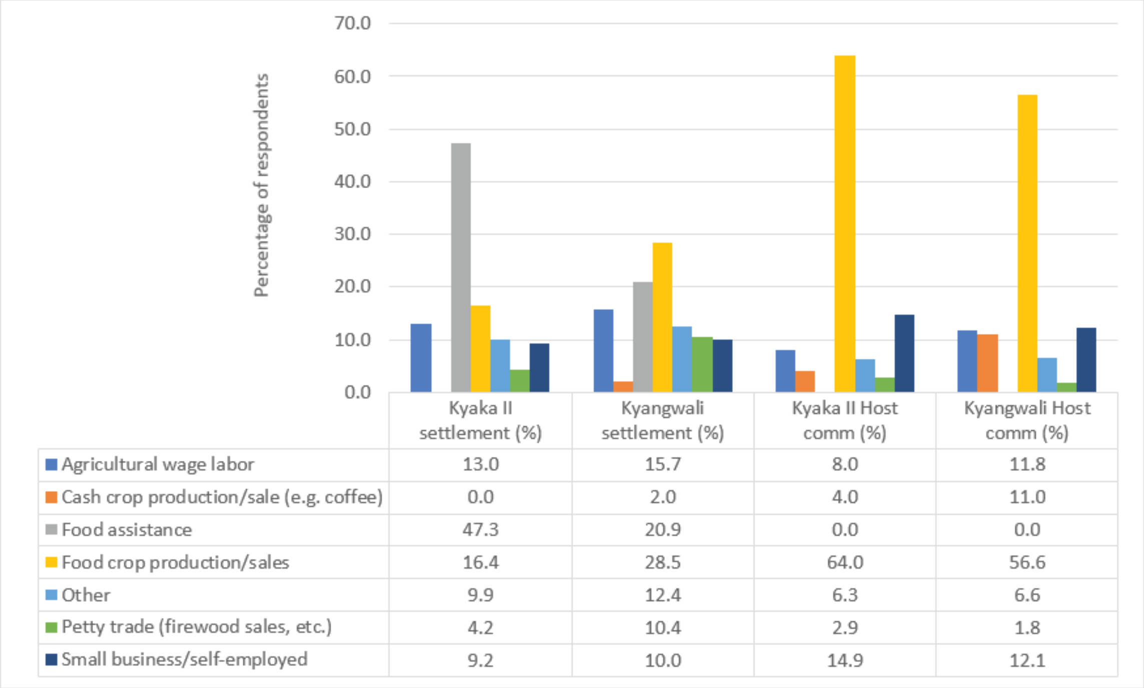
The majority of surveyed households reported at least one member having a source of income, including from agricultural wage labor, production and sale of non-food cash crops (such as tobacco or coffee), food assistance (cash and in-kind), production and sale of food crops, or petty trade (such as firewood sale or a small business). In Kyangwali settlement, production and sale of food is the most prevalent income source (28.5 percent of households), followed by food assistance (20.9 percent), while in Kyaka II, the reverse is true, with a larger proportion relying mainly on food assistance (47.3 percent) followed by production and sale of food (16.4 percent) (Figure 4).

Within nearby host communities, the dominant source of income is the production and sale of food crops, reported by 56.6 percent of respondents in the Kyangwali host villages and 64 percent of those around Kyaka II. Significant proportions of respondents from both the refugee settlements and local villages are also engaged in small businesses such as roadside shops and market stalls, as well as providing agricultural wage labor. This was reported by more refugee households (15.7 percent in Kyangwali and 13 percent in Kyaka II) than host households (11.8 percent around Kyangwali and 8 percent around Kyaka II), probably because most refugee households lack access to sufficient land to use all their manpower cultivating their own crops and are therefore available to work for host community landowners.

A portion of respondents (12.4 percent in Kyangwali settlement and 6.3 percent in Kyaka II host villages), were engaged in other sources of income generation, such as temporary employment with NGOs, *boda boda* (motorbike) transport services, carpentry, tailoring, and alcohol brewing.

The Kyangwali refugee settlement ranks highest in terms of the proportion of respondents engaged in petty trade (10 percent). For refugees at Kyangwali, the dominant petty trade is the sale of firewood and charcoal sourced from the adjacent Bugoma CFR and other nearby forests. As discussed in 3.2 below, this trade is believed to be largely supplying Ugandan markets.

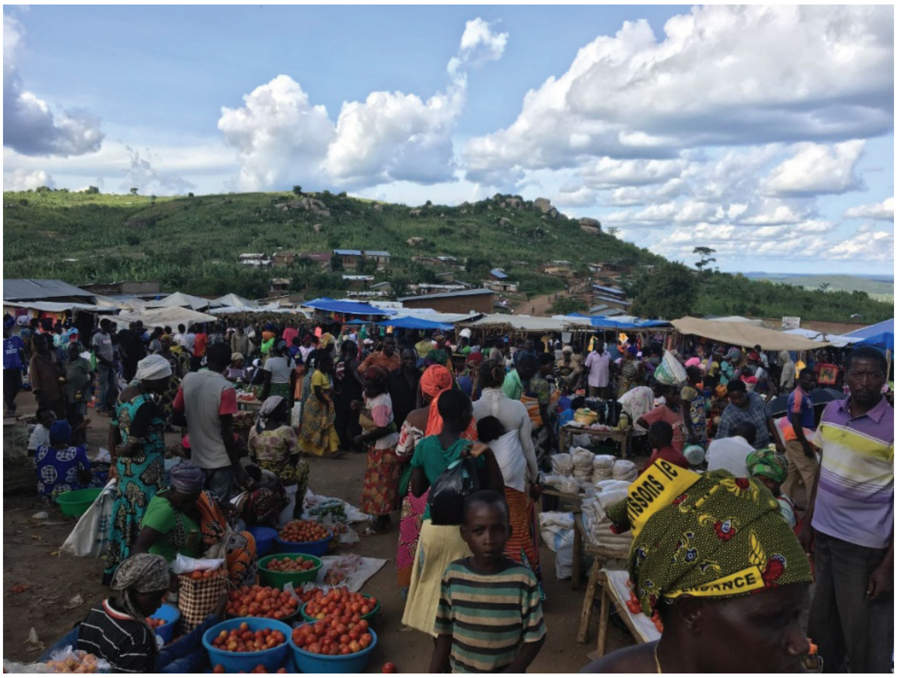
Figure 4. Sources of household income (percentage)



	Kyaka II settlement (%)	Kyangwali settlement (%)	Kyaka II Host comm (%)	Kyangwali Host comm (%)
■ Agricultural wage labor	13.0	15.7	8.0	11.8
■ Cash crop production/sale (e.g. coffee)	0.0	2.0	4.0	11.0
■ Food assistance	47.3	20.9	0.0	0.0
■ Food crop production/sales	16.4	28.5	64.0	56.6
■ Other	9.9	12.4	6.3	6.6
■ Petty trade (firewood sales, etc.)	4.2	10.4	2.9	1.8
■ Small business/self-employed	9.2	10.0	14.9	12.1

Overall, refugee households are engaged in a diversity of small-scale businesses while food crop production is more dominant for host community households. This could be partly because of the refugees' previous engagement in business in their countries of origin, the limitations on land access for agricultural activities following a recent reduction in plot sizes, and their short-term cash needs as new settlers. Commercial and business activities were observed to be stronger in Kyaka II settlement than in Kyangwali, as the former is in a more prosperous area closer to the commercial heartland of Uganda, with a short connection to the main Kampala highway.

Figure 5. Market in Kyaka II refugee settlement



© FAO/Arturo Gianvenuti

2.2 Fuel consumption for cooking

Within the refugee population, the majority of respondents at Kyaka II (77.5 percent) use charcoal as one of their cooking fuels, with only 31.5 percent using firewood (Table 6). The dominance of charcoal may reflect the scarcity of fuel and higher development status of this area, with relatively good access to markets and opportunities for refugees to engage in the national economy and thus be in a position to afford charcoal purchase and adopt more urbanized lifestyles. Meanwhile at Kyangwali, firewood is the main source of energy for 75.5 percent of refugee households and charcoal for 35.4 percent. Outside the refugee settlements, the majority of the respondents in both areas use firewood as their main source of cooking energy, with host households around Kyangwali settlement ranking higher (92.5 percent) than those around Kyaka II (78.8 percent). Households in the Kyaka II host villages also reported relatively high (15.3 percent) use of crop residues, mostly cassava stems and maize cobs, but in other locations this was reported by only 4–7 percent of households. This may be a further indication of woodfuel scarcity at Kyaka II.

Table 6. Refugee and host community fuel consumption

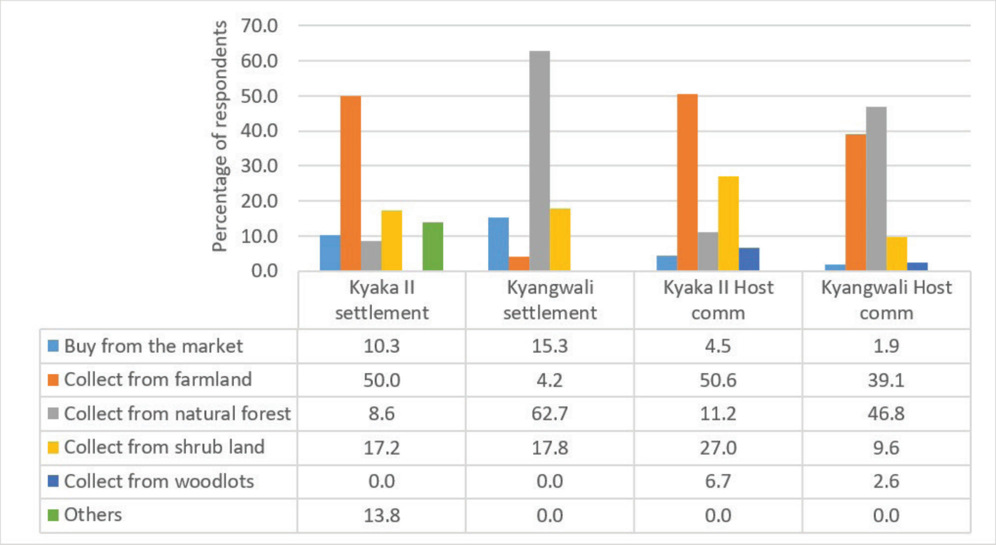
	Population using firewood (%)[a]	Average firewood consumption (kg pppd)[b]	Population using charcoal (%)[a]	Average charcoal consumption (kg pppd)	Total woodfuel consumption (kg pppd firewood-equivalent)[c]	Population using crop residues (%)[a]	Average crop residue consumption (kg pppd)
Refugees at Kyaka II	31.5	0.9	77.5	0.6	2.6	7.0	0.2
Refugees at Kyangwali	75.5	2.0	35.4	0.7	2.8	5.5	1.7
Host at Kyaka II	78.8	1.6	22.0	0.9	2.3	15.3	0.5
Host at Kyangwali	92.5	2.2	16.0	0.7	2.6	3.7	0.6

Note: a. Since multiple responses were permitted in the cooking fuel question, the sum of percentages for any location may exceed 100 percent. *b.* Kilograms of firewood per person per day are expressed on an air-dry basis. *c.* Total woodfuel consumption takes into account the rate of consumption of both firewood (expressed on an air-dry basis) and charcoal (expressed in firewood-equivalent, assuming a conversion efficiency of 20 percent).

The average consumption of firewood is higher (2.0 and 2.2 kg pppd) in the Kyangwali refugee settlement and host villages, respectively, than it is at Kyaka II, for both refugees and hosts (Table 6). This can probably be attributed to relatively high availability of remnant trees within the Kyangwali settlement (which covers 142 km^2), close proximity to open-access bushland on the Rift Valley escarpment, and the opportunity to harvest wood from Bugoma CFR. Several respondents mentioned sourcing firewood within Bugoma CFR, even though it may result in clashes with NFA forest guards. The usage rate of charcoal among the respondents is significantly higher at Kyaka II than Kyangwali, both for refugees and hosts.

The various sources of fuel for the two AoIs and for refugee and host communities are presented in Figure 6, where a distinct difference between the two settlements is apparent. The majority of refugee respondents from Kyangwali (62.7 percent) indicated that they collect firewood from the natural forest, whereas this source accounts for only 8.6 percent of respondents at Kyaka II. This reflects the close proximity of Kyangwali to Bugoma CFR (to the east) and to woodlands along the Rift Valley escarpment (to the west). The same holds true for the host villages surrounding the two settlements; 46 percent of local respondents around Kyangwali indicated that they collect their firewood from the natural forest. Meanwhile, a majority of households at Kyaka II (50 percent of refugees and 50.6 percent of host village households) rely on farmlands as a firewood source. This points to the limited availability of natural forests and the use of agricultural residues, agroforestry outputs, or remnant trees on farmland instead.

Figure 6. Sources of firewood (percentage)



	Kyaka II settlement	Kyangwali settlement	Kyaka II Host comm	Kyangwali Host comm
🟦 Buy from the market	10.3	15.3	4.5	1.9
🟧 Collect from farmland	50.0	4.2	50.6	39.1
■ Collect from natural forest	8.6	62.7	11.2	46.8
🟨 Collect from shrub land	17.2	17.8	27.0	9.6
🟦 Collect from woodlots	0.0	0.0	6.7	2.6
🟩 Others	13.8	0.0	0.0	0.0

2.3 Access to firewood

Both refugees and host community members at Kyangwali reported spending significant time on firewood collection trips, which include travel to the collection area, cutting, gathering, loading, and the journey back, taking an average of 4.7 hours and 4.2 hours per trip, respectively. The time range varies significantly from 30 minutes to as much as 10 hours. Respondents from the Kyaka II settlement meanwhile reported the shortest average fuel collection trip at 2.3 hours.

The difference in collection times can be explained by the different nature and availability of firewood sources. At Kyaka II and the surrounding villages, there are no consistent and well-defined fuel sources, such as a forest reserve or communal bushland, and respondents report that most areas with tree cover have been fenced off by landowners. A large natural forest immediately south of the settlement is managed by the military and is effectively off-limits. Households respond by collecting any form of biomass wherever they can find it, including around their compounds, within farmlands, and along paths. One respondent mentioned that the “picking starts the moment I leave the house”, returning home only when collection is satisfactory. So despite the shorter average trip lengths at Kyaka II, the shortage of firewood may actually be greater than at Kyangwali due to lower tree cover and access controls. Yet there is no value in travelling further in search of premium sources that do not exist or are not accessible. Meanwhile at Kyangwali, a longer foraging trip can deliver rewards, as it takes the collector to well-stocked woodlands or the government forest where high-quality wood is available with no effective restrictions. So the trips may be longer at Kyangwali, but the firewood is of higher quality and more abundant, once the harvesting location is reached.

The study also examined the number of headloads of firewood collected per week. As shown in Table 7, the largest proportion (31.6 percent) of households in the Kyaka II settlement collect six or more headloads of firewood per week. Similarly, in the Kyaka II host community, the largest group (32.1 percent) of households collect six or more headloads of firewood, followed by 28.5 percent who collect three loads per week.

By contrast, the majority of refugee household respondents at Kyangwali (28.5 percent) collect three headloads of firewood per week, followed by a significant proportion (20.5 percent), who collect only two loads per week. Only 15.9 percent of refugee households at Kyangwali collect six or more headloads per week. Among the Kyangwali host villages, it was again found that the majority of households (28.1 percent) gather three headloads of firewood per week and the second-largest proportion (25.1 percent) collect six or more. Refugees and host communities at Kyaka II therefore tend to make more frequent but shorter trips for fuel collection and bring back smaller and lower quality wood, in comparison with those from the Kyangwali area.

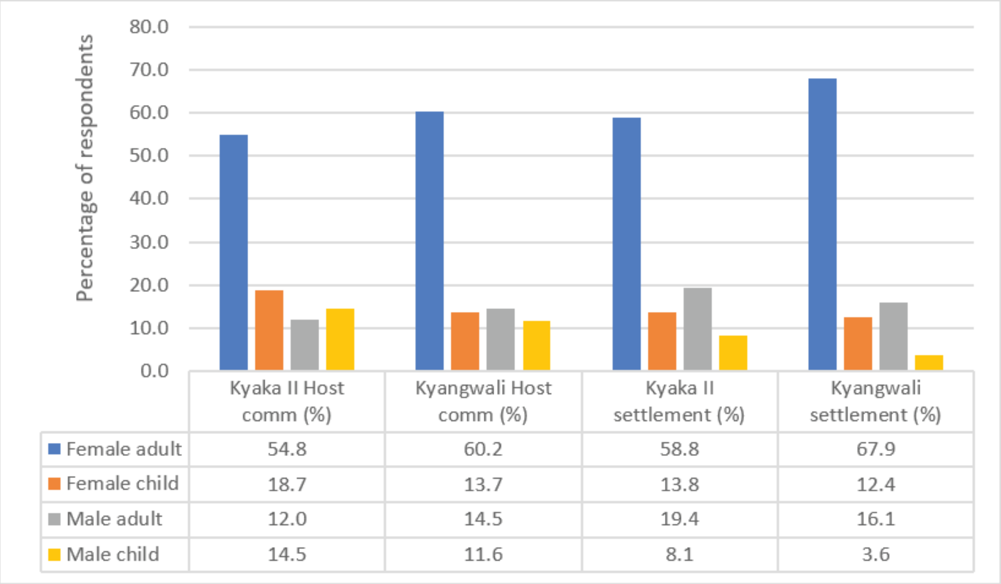
Table 7. Frequency of firewood collection per household (percentage)

No. of headloads collected per week	Refugees		Hosts	
	Kyaka II	Kyangwali	Kyaka II	Kyangwali
1	14.5	13.3	6.6	7.0
2	10.5	20.5	11.3	17.5
3	25.0	28.5	24.5	28.1
4	11.8	13.2	14.2	13.5
5	6.6	8.6	11.3	8.8
6 or more	31.6	15.9	32.1	25.1

The majority of respondents among both refugee and host households collect dead wood, with the highest proportions (77.3 and 76.3 percent, respectively) found in the Kyangwali settlement and host villages. An exception was found for the Kyaka II host communities, where the percentage of households collecting green wood (51.4) exceeds that of households collecting dead wood (48.6). For the rest of the survey areas, the use of green wood in cooking averages 23.5 percent. This again suggests that Kyaka II faces greater firewood scarcity, so people have to cut more green wood.

As Figure 7 shows, the majority of firewood collectors in both the refugee and host communities are adult females. The refugee respondents in the Kyangwali settlement have the highest percentage (67.9), while the host respondents in the surrounding of Kyaka II have the lowest (54.8) percentage of female adult fuel collectors. There is generally lower involvement of children in firewood collection, particularly among refugee households, perhaps for security reasons or due to the availability of child-engaging programs within the refugee settlements or due to trip length. Host respondents around Kyaka II have the highest number of children (18.7 percent female and 14.5 percent male) involved in the collection of firewood.

Figure 7. Categorization of firewood collectors among refugee and host communities (percentage)



	Kyaka II Host comm (%)	Kyangwali Host comm (%)	Kyaka II settlement (%)	Kyangwali settlement (%)
■ Female adult	54.8	60.2	58.8	67.9
■ Female child	18.7	13.7	13.8	12.4
■ Male adult	12.0	14.5	19.4	16.1
■ Male child	14.5	11.6	8.1	3.6

In a recent study by FAO exploring refugee and host communities' food security, well-being, and resilience in southwestern Uganda,[20] it was found that women have a key role to play in increasing the Resilience Capacity Index[21] of a given household, especially among host communities. The study further found that educated female refugees are more willing to integrate in the productive system of their host communities than their male counterparts, thereby influencing purchasing power at the household level (FAO and OPM 2018). Hence, rather than being confined to fuel collection and domestic cooking, the study draws attention to the potential role of women in improving household resilience to socioeconomic and natural shocks, by acting as drivers of the local economy through participation in diverse income-generating and production activities, in both refugee settlements and their hosting communities.

---

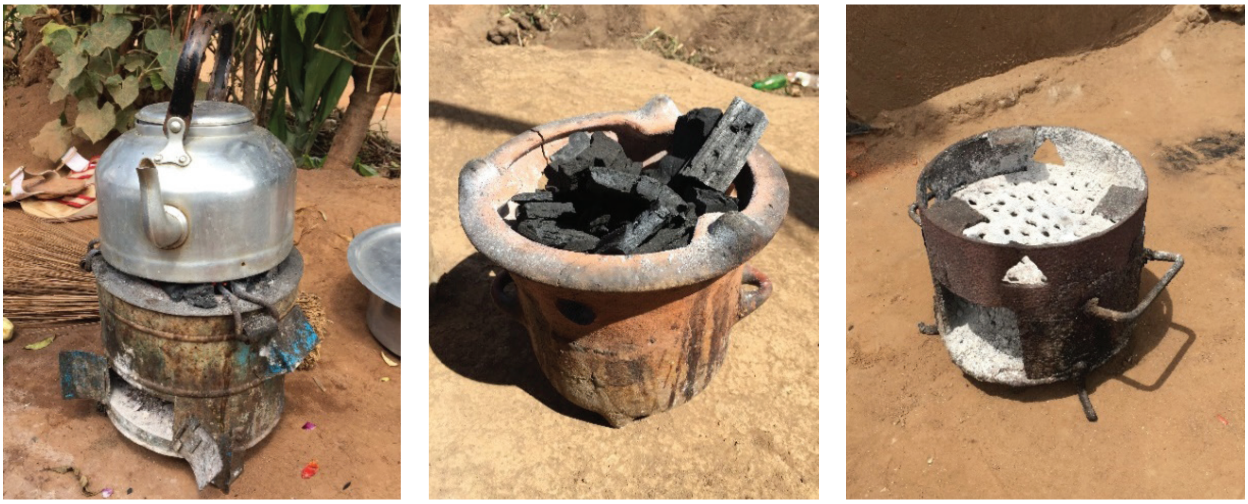
[20] www.fao.org/resilience/background/tools/rima/en/ The study used Resilience Index Measurement and Analysis (RIMA), a quantitative approach for analysing how households cope with shocks and stressors. Comparisons can be made between different types of households (for example, male-headed versus female-headed and urban versus rural) in a given country or area. RIMA provides evidence to more effectively design, deliver, monitor, and evaluate assistance to vulnerable populations, based on what they need most.

[21] The Resilience Capacity Index is a single statistic summarizing a region's status on 12 factors hypothesized to influence the ability of a region to bounce back from a future unknown stress.

2.4 Cooking stove ownership

Within the refugee settlements, diverse cooking devices exists. The largest proportion of refugee respondents at Kyaka II (41.5 percent) use improved charcoal stoves with an insulated clay liner inside a metal jacket, followed by the 'other' category (26 percent), which consists mostly of clay charcoal stoves locally known as *Mbabula* (Figure 8).

Figure 8. Typical charcoal stoves

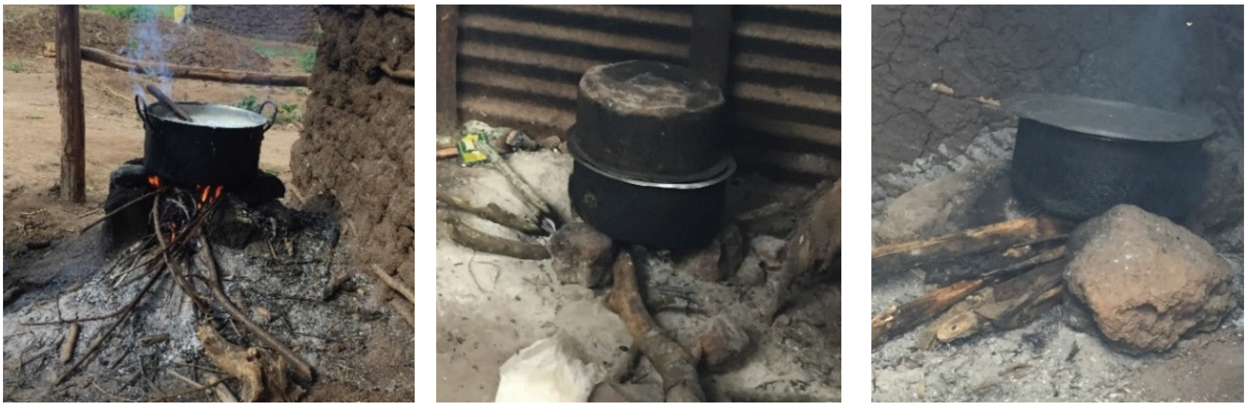


Metal charcoal stove with clay liner   *Mbabula* all-clay charcoal stove   Local all-metal charcoal *sigiri*

© FAO/Joseph Kirule (all three photos)

The three-stone fire is used by 23.5 percent of respondents in the Kyaka II settlement (Figure 9), while at the Kyangwali settlement, the use of the three-stone fire is more dominant at 43.6 percent, followed by firewood mud stoves for one pot and two pots at 34.3 percent and 23.8 percent, respectively. This result is consistent with the findings discussed in Section 2.2, where Kyaka II is characterized by higher use of charcoal, while the Kyangwali settlement is characterized by higher dependence on firewood.

Figure 9. Common three-stone fire arrangements

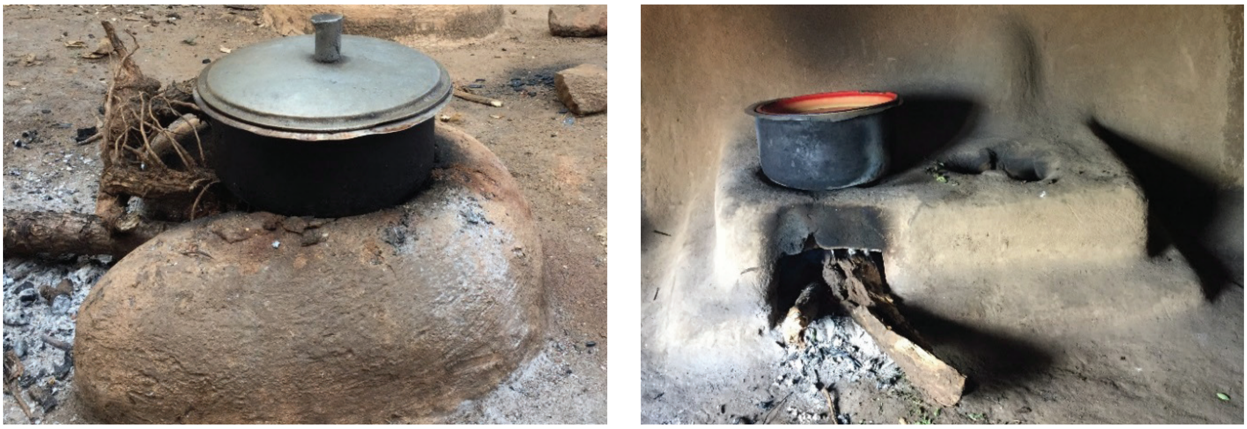


© FAO/Joseph Kirule (all three photos)

While the primary cooking system for the vast majority of host community households (87.3 percent and 65.2 percent in Kyaka II and Kyangwali, respectively) is the traditional three-stone fire, a significant portion of respondents in the Kyangwali communities also indicated use of a one-pot firewood mud stove (Figure 10). These respondents also reported the least use of metal-clad charcoal stoves with a clay liner.

Other types of cooking systems observed included three-pot mud stoves, mud stoves adapted to burn charcoal, and ground tunnel stoves. Overall, the two most prevalent cooking systems were the three-stone fire, followed by the one-pot mud stove.

Figure 10. Typical mud stoves

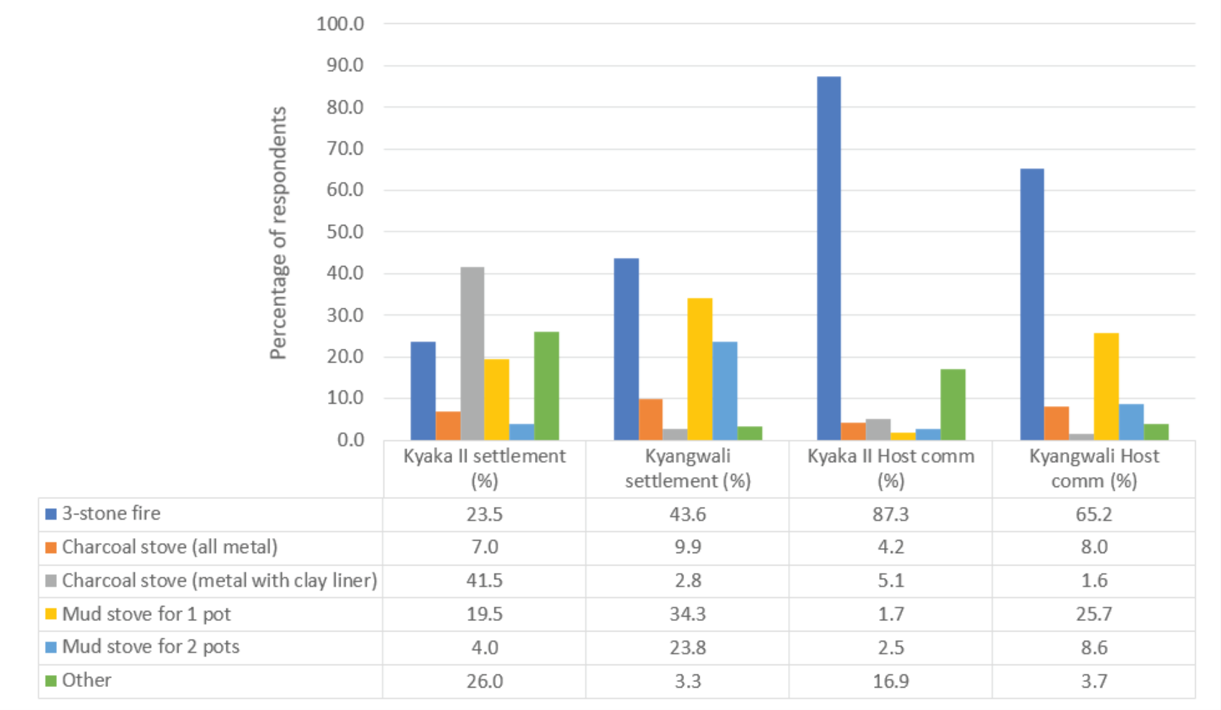


1-pot firewood mud stove

2-pot firewood mud stove

© FAO/Joseph Kirule (both photos)

Figure 11. Household cooking systems (percentage)



	Kyaka II settlement (%)	Kyangwali settlement (%)	Kyaka II Host comm (%)	Kyangwali Host comm (%)
■ 3-stone fire	23.5	43.6	87.3	65.2
■ Charcoal stove (all metal)	7.0	9.9	4.2	8.0
■ Charcoal stove (metal with clay liner)	41.5	2.8	5.1	1.6
■ Mud stove for 1 pot	19.5	34.3	1.7	25.7
■ Mud stove for 2 pots	4.0	23.8	2.5	8.6
■ Other	26.0	3.3	16.9	3.7

Note: Since multiple responses were permitted in the cooking system question, the sum of percentages for any location may exceed 100 percent.

2.5 Cookstove disadvantages

The majority of respondents in both the refugee settlements and host villages mentioned smoke emissions as the main disadvantage of the thee-stone fire, with the highest proportion found in the Kyaka II settlement (61.1 percent) and the Kyangwali host communities (52.9 percent). A significant proportion of respondents also associated the open fire with high fuel requirements across all surveyed communities, although the Kyangwali village residents had the highest percentage experiencing this challenge (21.6 percent) (Table 8). Further, significant proportions of respondents across the four locations mentioned disadvantages in the 'other' category, most commonly the risk of toppling the cooking pot during stirring due to instability, accidents due to poor containment of the fire, exhausting and labor-intensive cooking processes, poor safety for children, and blackening of cooking pots.

Table 8. Disadvantages of using the three-stone fire (percentage)

	Refugees		Hosts	
Disadvantage	Kyaka II	Kyangwali	Kyaka II	Kyangwali
Too much smoke	61.1	50.9	48.9	52.9
Other	25.0	20.0	20.7	24.5
Expensive to use due to fuel costs	8.3	7.3	9.8	0.0
Requires a lot of fuel	5.6	16.4	18.5	21.6
Food undercooked	0.0	5.5	2.2	1.0

The results reveal that users of the three-stone fire see smoke emission as its main drawback, followed by a range of other disadvantages other than high fuel consumption. This has implications for potential interventions that target efficiency enhancement, given that high fuel consumption was not ranked in the top two drawbacks of the three-stone fire by any respondent group. Fuel economy may not be the highest priority for the surveyed groups.

Regarding the use of one-pot mud stoves, respondents associated these stoves with high fuel requirements, with the highest number of respondents mentioning this drawback found in the Kyaka II host community (50 percent), followed by those in the Kyangwali settlement (21.3 percent) (Table 9). More than half of respondents mentioned disadvantages in the 'other' category, such as the stove breaking easily, cooking slowly, getting damaged by rain or allowing the pot to rotate during stirring. Such disadvantages can usually be traced to design, construction technique, or quality of materials, which could be remedied relatively easily.

Table 9. Disadvantages of using one-pot mud stove (percentage)

Disadvantage	Refugees		Hosts	
	Kyaka II	Kyangwali	Kyaka II	Kyangwali
Other	50.0	48.9	50.0	40.9
Too much smoke	26.3	17.0	0.0	38.6
Expensive to use due to fuel costs	10.5	10.6	0.0	2.3
Requires a lot of fuel	7.9	21.3	50.0	18.2
Food undercooked	5.3	2.1	0.0	0.0

Smoke is perceived as a less problematic issue with the mud stove than the three-stone fire. There are, instead, a variety of 'other' issues reported by 40–50 percent of respondents. This suggests that it may be quite hard to find a one-size-fits-all alternative to the open fire. Also noteworthy is that high fuel consumption is mentioned by 50 percent of hosts at Kyaka II, but not seen as such a serious problem by any other group. This again points to fuel scarcity challenges at Kyaka II.

2.5.1 Source of cookstoves

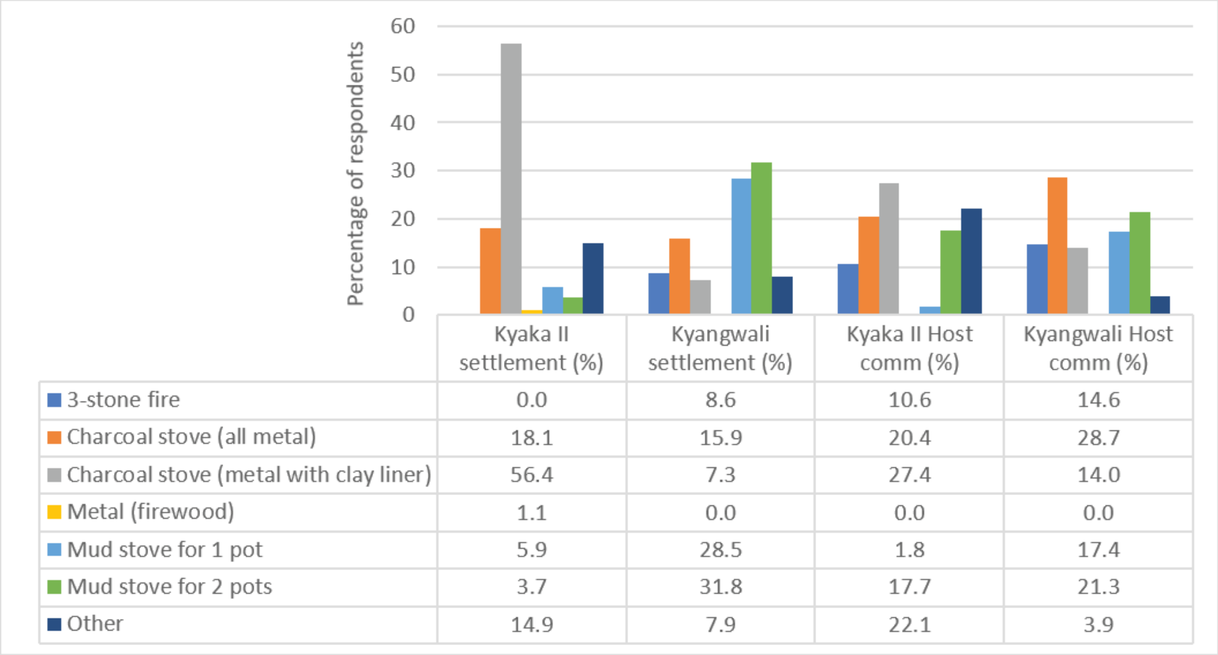
The source of cooking stoves was investigated and the results in Table 10 reveal that the majority of stoves used by households in Kyaka II were bought from the market, while at Kyangwali they were self-produced. The situation is similar among host communities.

About 72 percent of host households and 41 percent of refugee households at Kyaka II source their stoves from the market, presumably because more households here use charcoal and would need a prefabricated stove with which to use it. The highest proportions of stoves given by NGOs and UN agencies were also reported at the Kyaka II settlement (25.1 percent). These were mainly charcoal stoves with an insulated clay liner in a metal jacket. Negligible numbers of stoves from NGOs and UN agencies were found in the other locations. Among the recipients of these donated charcoal stoves, there was a general lack of satisfaction regarding the size (too small) and consequent inability to prepare sufficient food for large families. Several users were also concerned about low stove quality and short life span (6–12 months). In most cases, they use them along with other stove types.

Table 10. Sources of cookstoves (percentage)

Stove source	Refugees		Hosts	
	Kyaka II	Kyangwali	Kyaka II	Kyangwali
Market	41.0	11.9	72.2	27.0
Self-produced	31.3	77.6	19.4	69.7
NGO/UN agency	25.1	3.0	0.0	0.0
Other	2.1	3.7	8.3	2.2
Relatives	0.5	3.7	0.0	1.1

Figure 12. Cookstove preferences (percentage)

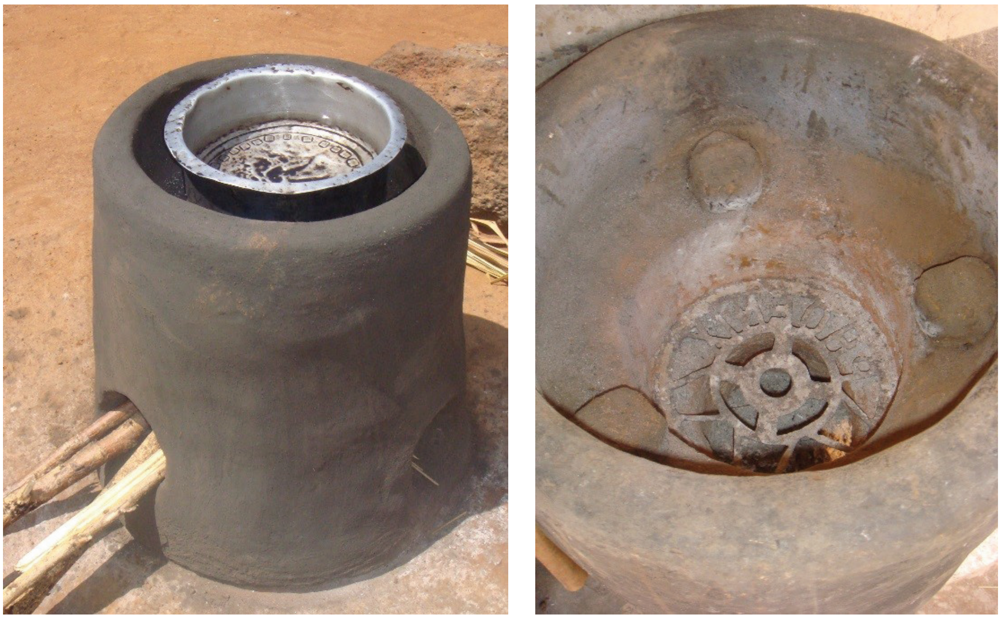


	Kyaka II settlement (%)	Kyangwali settlement (%)	Kyaka II Host comm (%)	Kyangwali Host comm (%)
■ 3-stone fire	0.0	8.6	10.6	14.6
■ Charcoal stove (all metal)	18.1	15.9	20.4	28.7
■ Charcoal stove (metal with clay liner)	56.4	7.3	27.4	14.0
■ Metal (firewood)	1.1	0.0	0.0	0.0
■ Mud stove for 1 pot	5.9	28.5	1.8	17.4
■ Mud stove for 2 pots	3.7	31.8	17.7	21.3
■ Other	14.9	7.9	22.1	3.9

Mud stoves (as the second most used stove type) were reported to be either self-produced or built by trained individuals in the community, who were presumably themselves trained by NGOs. Field observations suggest that the quality of these stoves is often poor, and the services of the trained individuals are not known to many families.

Overall, limited awareness of alternative and modern cooking technologies was reported. There are homes where energy efficiency practices only come to mind when there is a need to cook hard, dry foodstuffs, such as beans. Some households who own charcoal stoves reported using them infrequently due to difficulty affording high charcoal prices. In the absence of charcoal, it was observed that households switch to three-stone fires. Similarly, due to the uncertainty of continuous supply of one fuel type and for ease of use, several households preferred dual-fuel stoves that can use either charcoal or firewood (Figure 13).

Figure 13. Dual-fuel mud stove



© ENDEV/GIZ (both photos)

2.6 Challenges associated with energy access for cooking

When asked whether respondents or members of their households had experienced any serious security threats while searching for firewood, the majority responded that they had not. However, the search for firewood is perceived by the respondents as a potential cause of mild tension between refugees and host communities when they find themselves competing for the same sources. In isolated cases, both refugee and host community members had been threatened by security personnel guarding forest reserves. These cases, as reported to the survey team, usually involve confiscation of firewood and tools, but occasionally physical assault or hard labor as punishment.

3 TREE COVER, LAND USE/LAND COVER AND WOODY BIOMASS RESOURCES FINDINGS

Uganda's natural forest vegetation may be categorized into three broad types: tropical high forest well-stocked (THF), tropical high forest low-stocked (THFL), and woodlands. In western Uganda, the THFs are mainly found in CFRs (Budongo, Bugoma, Kalinzu-Maramagambo, and Katsyoha-Kitomi) and in NPs (Bwindi Impenetrable, Kibale, Mgahinga, Rwenzori Mountains, and Semuliki). THFL is rare in the west, while savannah woodland and bushland are confined to drier areas (MWE and WB 2017; NBS 2009). Plantations are meanwhile differentiated into broad-leaved and coniferous plantations (MWE 2018).

Geospatial analysis was undertaken to provide information on the status and changes in tree cover, land use and land cover (LULC), and biomass stocks. Remote sensing techniques were used to identify the area of tree cover loss each year between 2001 and 2018 within the 5 km and 15 km buffer zones from the refugee settlement boundaries. The data on tree cover loss were overlaid with refugee and host community population data to explore potential relationships. In addition, changes in biomass stock between 2000 and 2017 were assessed, based on the LULC changes. Details on the methodology and data sets used are in Annex 1.

3.1 Kyaka II settlement

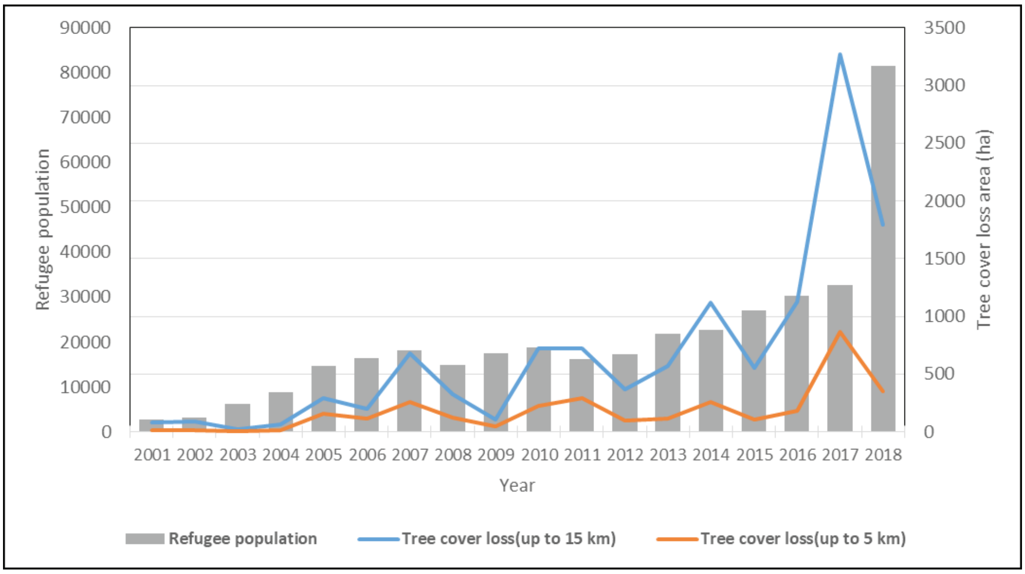
After a gradual rise in the refugee population at Kyaka II between 2001 and 2017 (with some minor annual fluctuations), a much sharper population increase was observed in 2018. An overall rise in the annual rate of tree cover loss was seen between 2001 and 2016, but a sudden increment in tree cover loss was observed in 2017 (Figure 14). This came one year *before* the major influx of Congolese refugees that took place from December 2017. It does not therefore seem to have been linked to their arrival, unless there was a significant time lag between arrival and registration (which was not the case according to UNHCR). The overall tree cover loss over the period 2001-2018 was more pronounced in the 15 km buffer than in the 5 km buffer, suggesting a stronger association with host community actions than refugees.

Within the 15 km buffer, 12,093 ha of tree cover was lost between 2001 and 2018. Nearly half of this loss (about 49 percent) occurred in areas where natural forest was converted to other type of LULC[22] (Figure 15). A further 41 percent of the tree cover loss occurred on land that was already classified as 'other land', probably entailing removal of remnant woody vegetation.

---

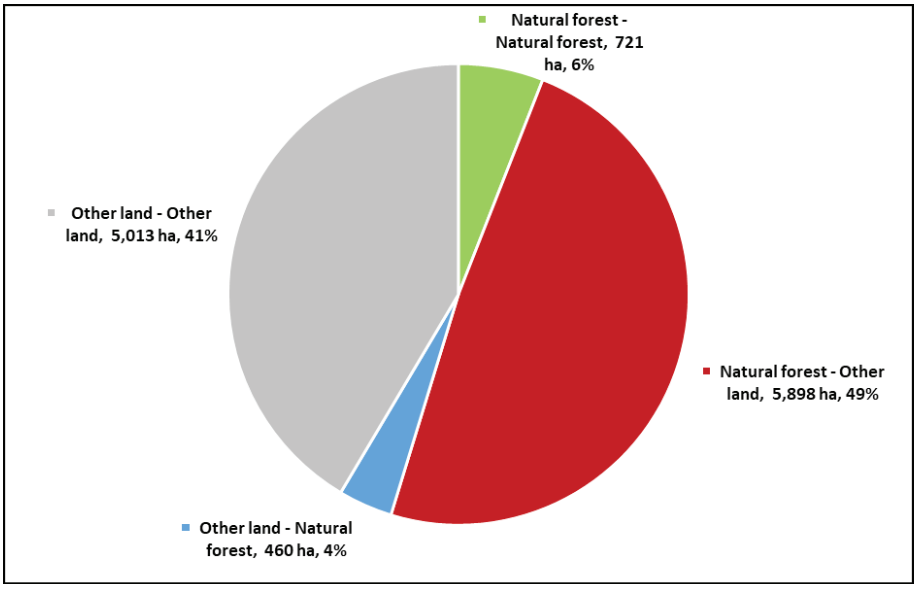
[22] The THF, THFL, and Woodland categories of the national LULC map are considered as natural forest. The remaining classes are considered as other land (see 'Change detection' in Annex 1, Section B).

Figure 14. Kyaka II refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018)



Source: Hansen et al. 2013; refugee population: UNHCR.

Figure 15. Tree cover loss within LULC transition classes in Kyaka II 15 km buffer (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; LULC: NFA.

Four forest reserves (Katenta and Mpara LFRs as well as Muinaina and Rwensambya CFRs) fall entirely within the 15 km buffer of the Kyaka II settlement. The Buhungiro and Kasolo CFRs also partly overlap the 15 km buffer. Some scattered gains of biomass were observed in both the 5 km and 15 km buffers, while substantial and scattered tree cover loss is observed right across the Kyaka II AoI (Figure 17). Biomass loss broadly follows the tree cover loss pattern and is mostly concentrated in the north and northwestern part. High loss of biomass is attributable to the conversion of THF, THFL, woodland, and bushland to lower stock LULC classes (Table 11 and Table 12). Some moderate biomass gain was also found in broad-leaved plantations and subsistence farmland. From 2000 to 2017, net biomass changes were −39% and −40% in the 5 km and 15 km buffer areas, respectively. Thus, there was a greater percentage of biomass loss further away from the settlement than closer to it, suggesting that this loss was probably not directly linked to the presence of the refugees.

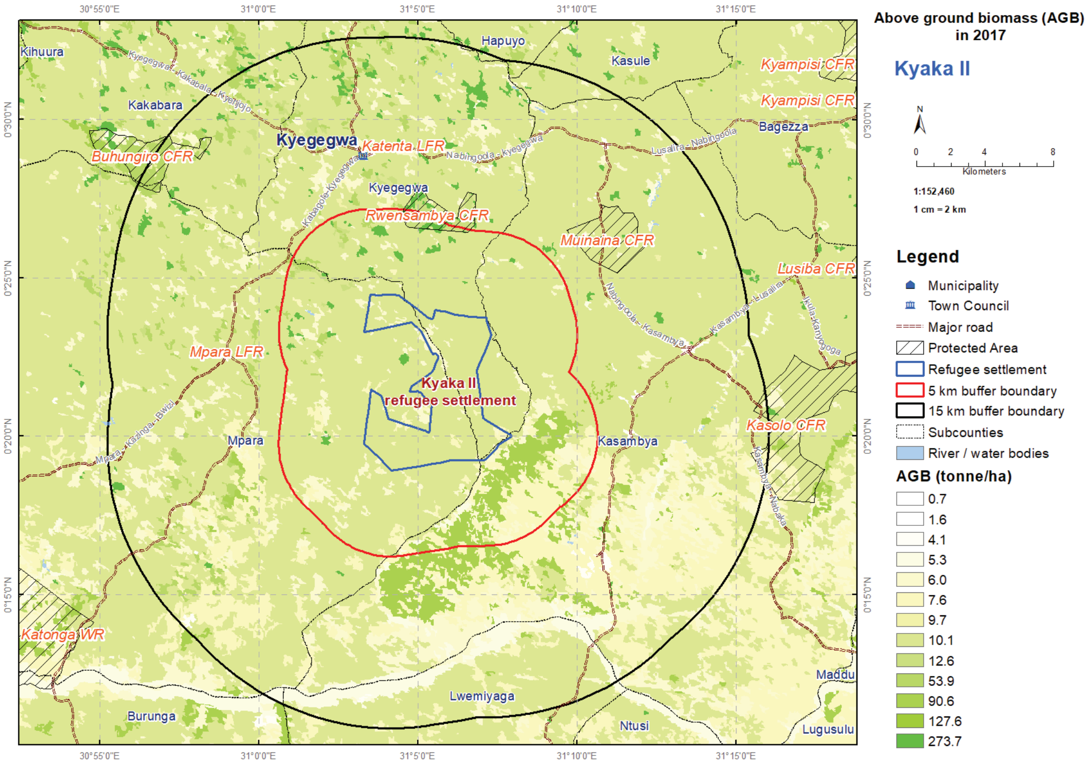
Table 11. Changes in LULC and biomass stock in Kyaka II 5 km buffer (2000-2017)

LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	0	0	0	0	0	0	—
Bushland	4,877	2,138	−2,739	37,188	16,305	−20,883	−56
Commercial farmland	0	0	0	0	0	0	—
Grassland	965	2,241	1,276	5,132	11,910	6,778	132
Impediment (bare soil, bare rock, and so on)	0	0	0	0	0	0	—
Plantations, broad-leaved	0	361	361	0	32,734	32,734	—
Plantations, coniferous	0	0	0	0	0	0	—
Subsistence farmland	15,357	23,932	8,575	155,229	241,911	86,682	56
THF	1,363	211	−1,152	173,903	26,984	−146,919	−84
THFL	868	299	−569	237,693	81,773	−155,920	−66
Water	0	7	7	0	0	0	—
Wetland	0	96	96	0	154	154	—
Woodland	7,502	1,646	−5,856	94,836	20,807	−74,029	−78
				703,981	**432,578**	**−271,403**	**−39**

Table 12. Changes in LULC and biomass stock in Kyaka II 15 km buffer (2000-2017)

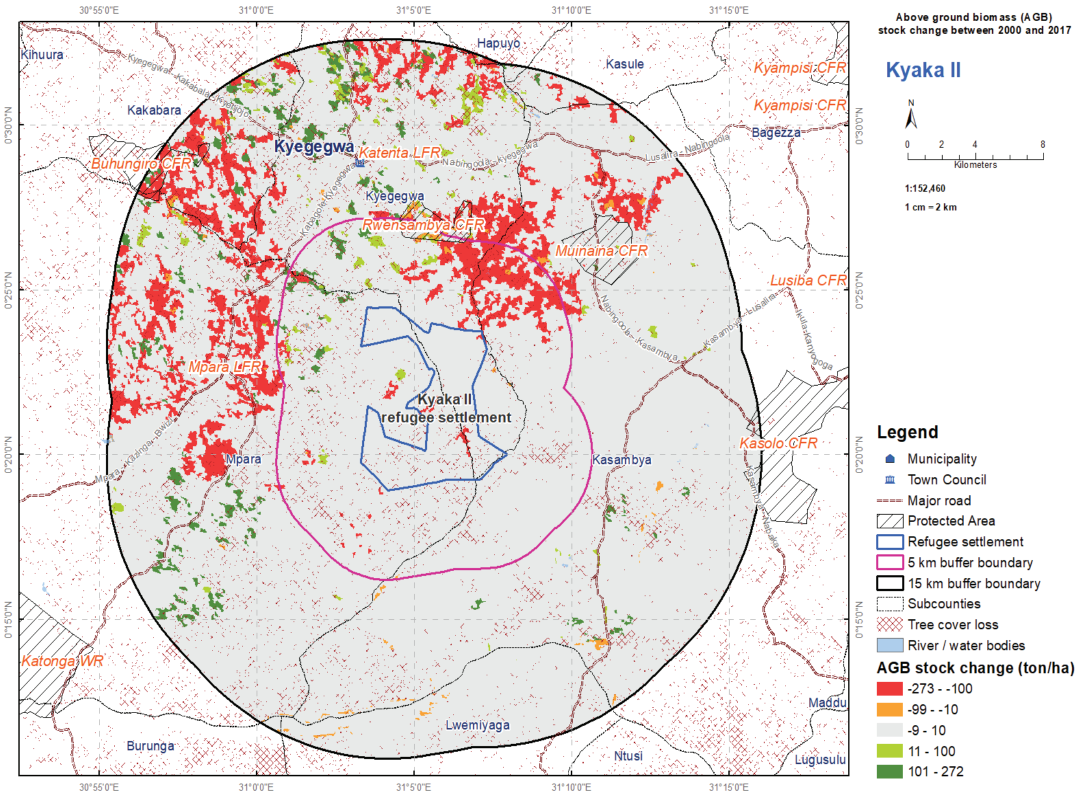
LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	0	429	429	0	1,744	1,744	—
Bushland	17,616	11,672	−5,944	134,332	89,011	−45,321	−34
Commercial farmland	0	0	0	0	0	0	—
Grassland	9,328	13,288	3,960	49,583	70,630	21,047	42
Impediment (bare soil, bare rock, and so on)	0	90	90	0	61	61	—
Plantations, broad-leaved	0	1,548	1,548	0	140,306	140,306	—
Plantations, coniferous	0	0	0	0	0	0	—
Subsistence farmland	57,181	89,344	32,163	577,998	903,117	325,119	56
THF	8,225	2,623	−5,602	1,049,731	334,714	−715,017	−68
THFL	2,997	808	−2,189	820,588	221,041	−599,547	−73
Water	42	48	6	0	0	0	—
Wetland	2,097	2,626	529	3,345	4,190	845	25
Woodland	29,015	4,025	−24,990	366,799	50,887	−315,912	−86
				3,002,376	**1,815,701**	**−1,186,675**	**−40**

Figure 16. Biomass stock in Kyaka II settlement and 5 km and 15 km buffers (2017)


Above ground biomass (AGB) in 2017
Kyaka II
N
0 2 4 8
Kilometers
1:152,460
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
AGB (tonne/ha)
0.7
1.6
4.1
5.3
6.0
7.6
9.7
10.1
12.6
53.9
90.6
127.6
273.7
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
31°15'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
Kihuura
Hapuyo
Kasule
Kyampisi CFR
Kyampisi CFR
Kakabara
Bagezza
Kyegegwa
Katenta LFR
Buhungiro CFR
Kyegegwa
Rwensambya CFR
Muinaina CFR
Lusiba CFR
Mpara LFR
Kyaka II refugee settlement
Kasolo CFR
Mpara
Kasambya
Katonga WR
Maddu
Lwemiyaga
Burunga
Ntusi
Lugusulu

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA.

Figure 17. Biomass stock changes in Kyaka II settlement and 5 km and 15 km buffers (2000–2017)


Above ground biomass (AGB) stock change between 2000 and 2017
Kyaka II
N
0 2 4 8
Kilometers
1:152,460
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Tree cover loss
River / water bodies
AGB stock change (ton/ha)
-273 - -100
-99 - -10
-9 - 10
11 - 100
101 - 272
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
31°15'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
Kihuura
Hapuyo
Kasule
Kyampisi CFR
Kyampisi CFR
Kakabara
Bagezza
Kyegegwa
Katenta LFR
Buhungiro CFR
Kyegegwa
Rwensambya CFR
Muinaina CFR
Lusiba CFR
Mpara LFR
Kyaka II refugee settlement
Kasolo CFR
Mpara
Kasambya
Katonga WR
Maddu
Lwemiyaga
Burunga
Ntusi
Lugusulu

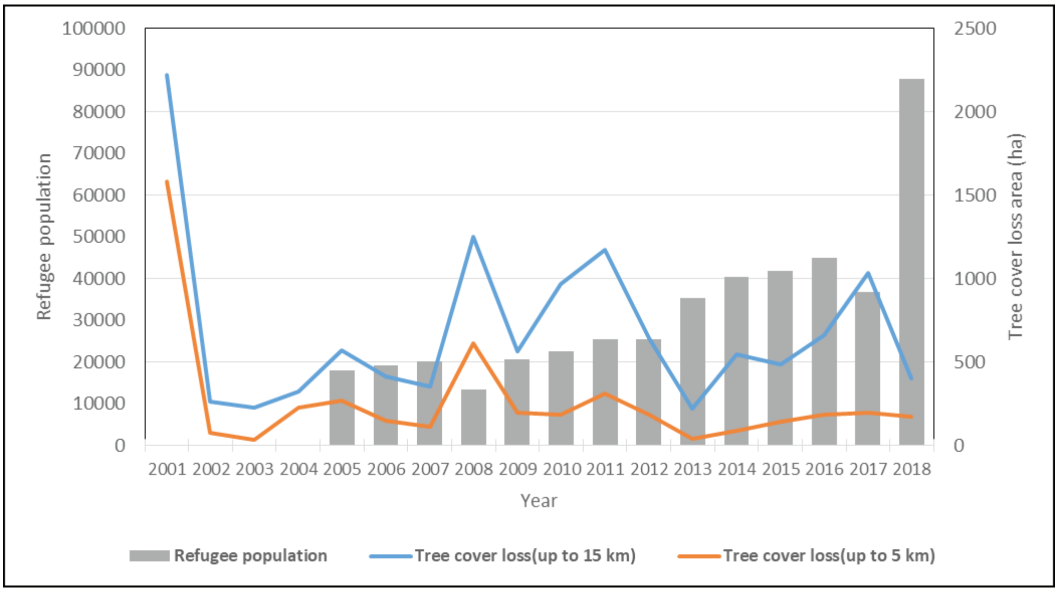
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA; tree cover loss: Hansen et al. 2013.

3.2 Kyangwali settlement

Tree cover loss at Kyangwali was at its peak in 2001. Annual tree cover loss has since decreased significantly and has continued to fluctuate (Figure 18). In this AoI, there is no clear evidence of direct correlation between tree cover loss and the refugee population trend.

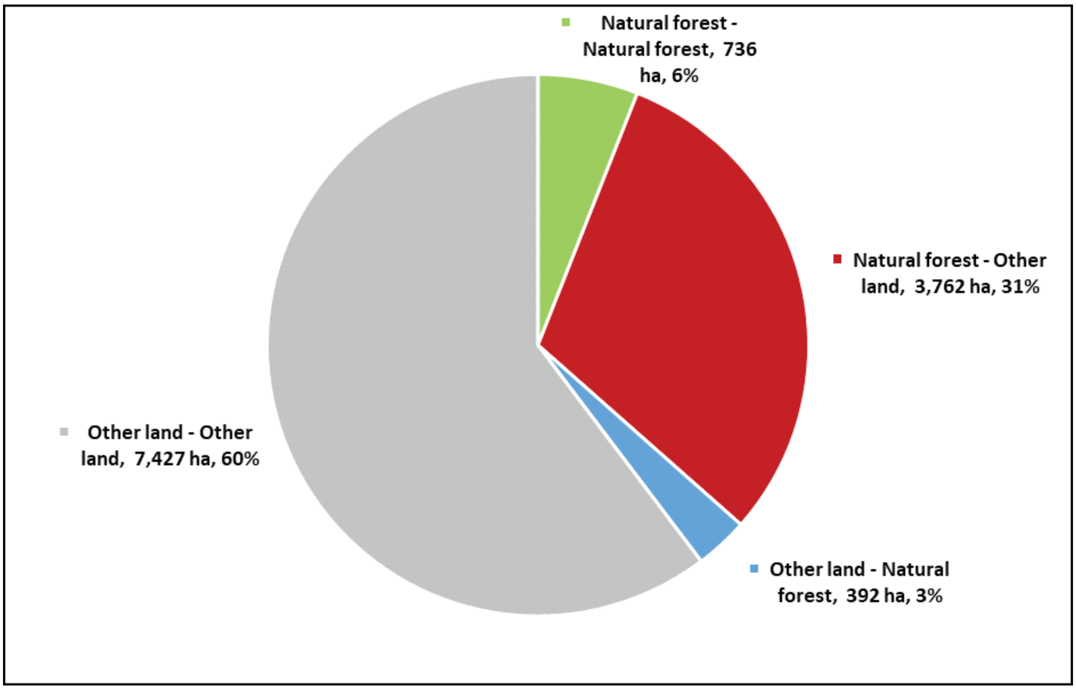
Of the 12,318 ha of tree cover loss occurring between 2001 and 2018 within the 15 km buffer, about 60 percent took place in stable 'other' land. The next highest loss (about 31 percent) was observed in the transition from natural forest[23] to other land (Figure 19).

Figure 18. Kyangwali refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; refugee population: UNHCR.

Figure 19. Tree cover loss within LULC transition classes in Kyangwali 15 km buffer (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; LULC: NFA.

---

[23] The THF, THFL, and Woodland categories of the national LULC map are considered as natural forest. The remaining classes are considered as other land (See 'Change detection' in Annex 1, Section B).

The settlement directly abuts Bugoma CFR, in which high concentrations of biomass were observed (Figure 20). Tree cover loss mainly occurred in the eastern part of the Kyangwali settlement near the CFR, which is characterized by THF (Figure 21). The high biomass loss in this AoI, mostly due to the transition of both THF and THFL and woodland (Table 13 and Table 14), follows a similar pattern to the tree cover loss (Figure 18). Despite this tree cover loss, a moderate *increase* of biomass within the boundary of the settlement is observed. This is due to the conversion of grassland/bushland to subsistence farmland. From 2000 to 2017, net biomass changes were −13 percent and −17 percent in the 5 km and 15 km buffer areas, respectively. Again, the percentage loss is greater in the 15 km buffer than the 5 km buffer, suggesting a greater influence of host populations than refugees on biomass loss over this 17 year period.

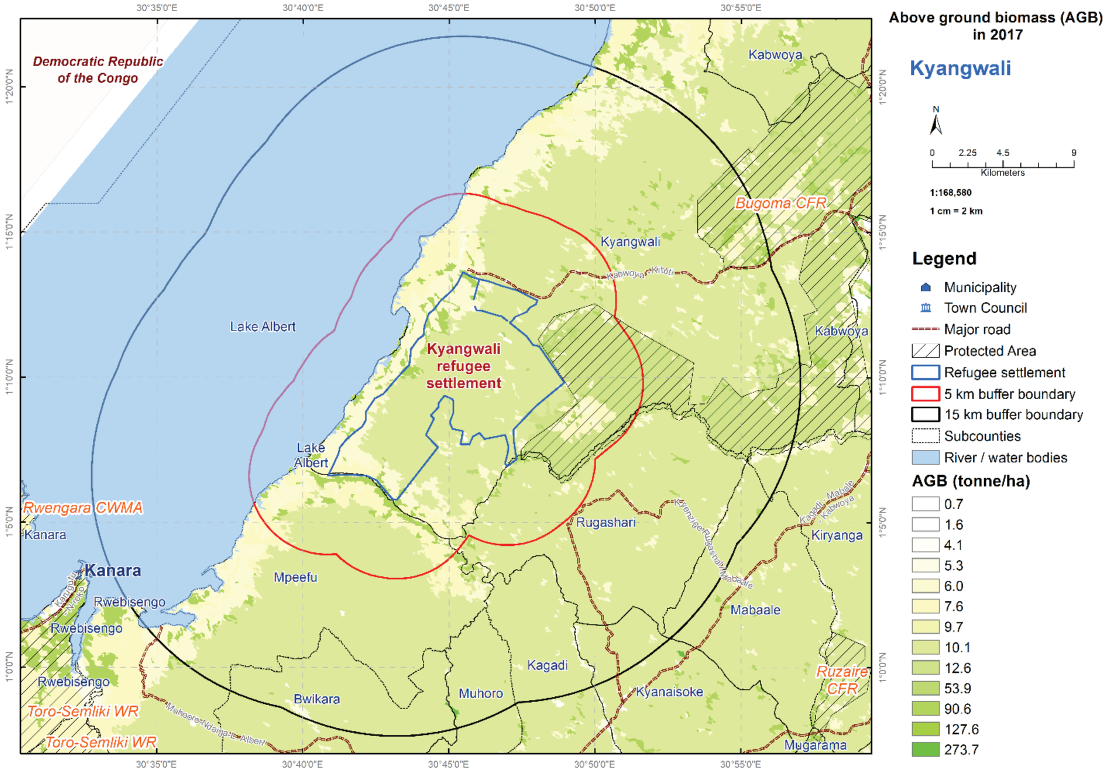
Table 13. Changes in LULC and biomass stock in Kyangwali 5 km buffer (2000-2017)

LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	0	76	76	0	310	310	—
Bushland	12,056	5,137	−6,919	91,932	39,173	−52,759	−57
Commercial farmland	0	0	0	0	0	0	—
Grassland	3,824	3,747	−77	20,326	19,917	−409	−2
Impediment (bare soil, bare rock, and so on)	0	0	0	0	0	0	—
Plantations, broad-leaved	0	0	0	0	0	0	—
Plantations, coniferous	0	0	0	0	0	0	—
Subsistence farmland	12,622	19,885	7,263	127,591	201,008	73,417	58
THF	630	409	−221	80,436	52,144	−28,292	−35
THFL	4,844	4,036	−808	1,325,789	1,104,699	−221,090	−17
Water	6,930	7,071	141	0	0	0	—
Wetland	0	78	78	0	124	124	—
Woodland	1,045	1,511	466	13,205	19,105	5,900	45
				1,659,279	**1,436,480**	**−222,799**	**−13**

Table 14. Changes in LULC and biomass stock in Kyangwali 15 km buffer (2000-2017)

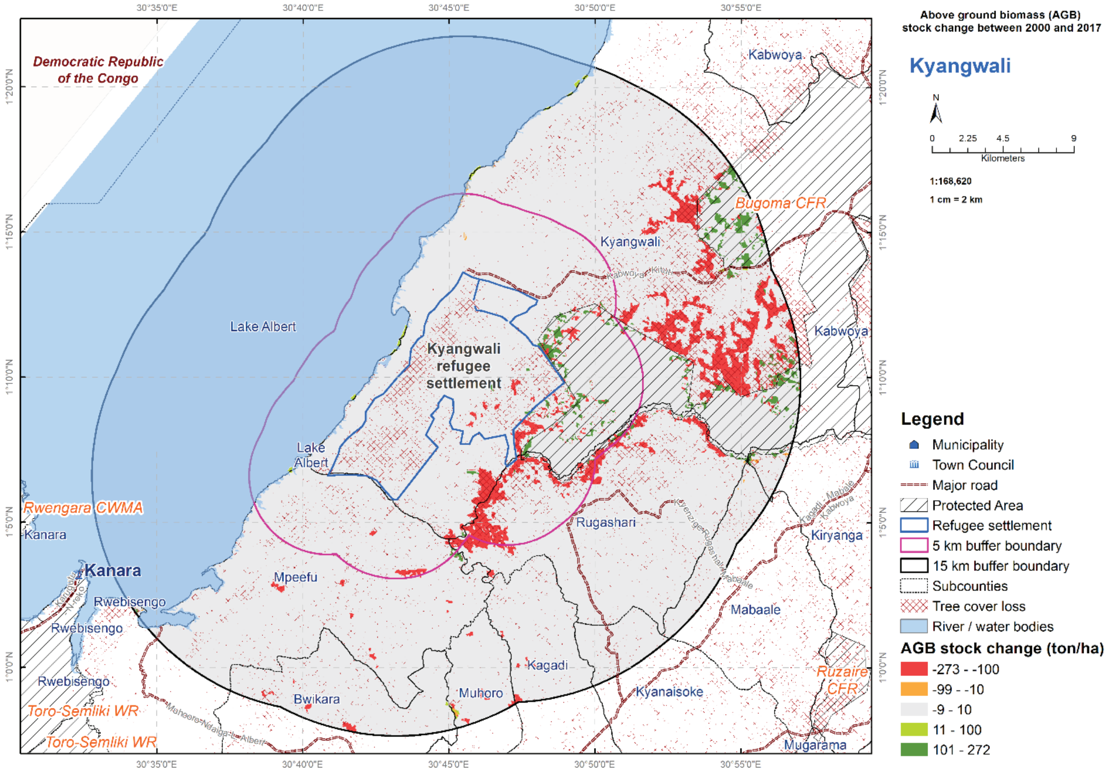
LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	0	122	122	0	495	495	—
Bushland	16,781	10,986	−5,795	127,965	83,777	−44,188	−35
Commercial farmland	0	0	0	0	0	0	—
Grassland	11,650	5,656	−5,994	61,924	30,065	−31,859	−51
Impediment (bare soil, bare rock, and so on)	0	0	0	0	0	0	—
Plantations, broad-leaved	0	31	31	0	2,821	2,821	—
Plantations, coniferous	0	0	0	0	0	0	—
Subsistence farmland	52,157	70,460	18,303	527,224	712,234	185,010	35
THF	1,803	737	−1,066	230,132	94,079	−136,053	−59
THFL	11,625	9,195	−2,430	3,181,857	2,516,877	−664,980	−21
Water	49,544	49,795	251	0	0	0	—
Wetland	51	281	230	82	448	366	446
Woodland	6,284	2,631	−3,653	79,441	33,267	−46,174	−58
				4,208,625	**3,474,063**	**−734,562**	**−17**

Figure 20. Biomass stock in Kyangwali settlement and 5 km and 15 km buffers (2017)


Above ground biomass (AGB) in 2017
Kyangwali
0 2.25 4.5 9
Kilometers
1:168,580
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
AGB (tonne/ha)
0.7
1.6
4.1
5.3
6.0
7.6
9.7
10.1
12.6
53.9
90.6
127.6
273.7
Democratic Republic of the Congo
Lake Albert
Kyangwali refugee settlement
Kyangwali
Kabwoya
Bugoma CFR
Rugashari
Kiryanga
Mabaale
Mpeefu
Kagadi
Muhoro
Bwikara
Kyanaisoke
Ruzaire CFR
Mugarama
Rwengara CWMA
Kanara
Rwebisengo
Toro-Semliki WR
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
1°20'0"N
1°15'0"N
1°10'0"N
1°5'0"N
1°0'0"N

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA.

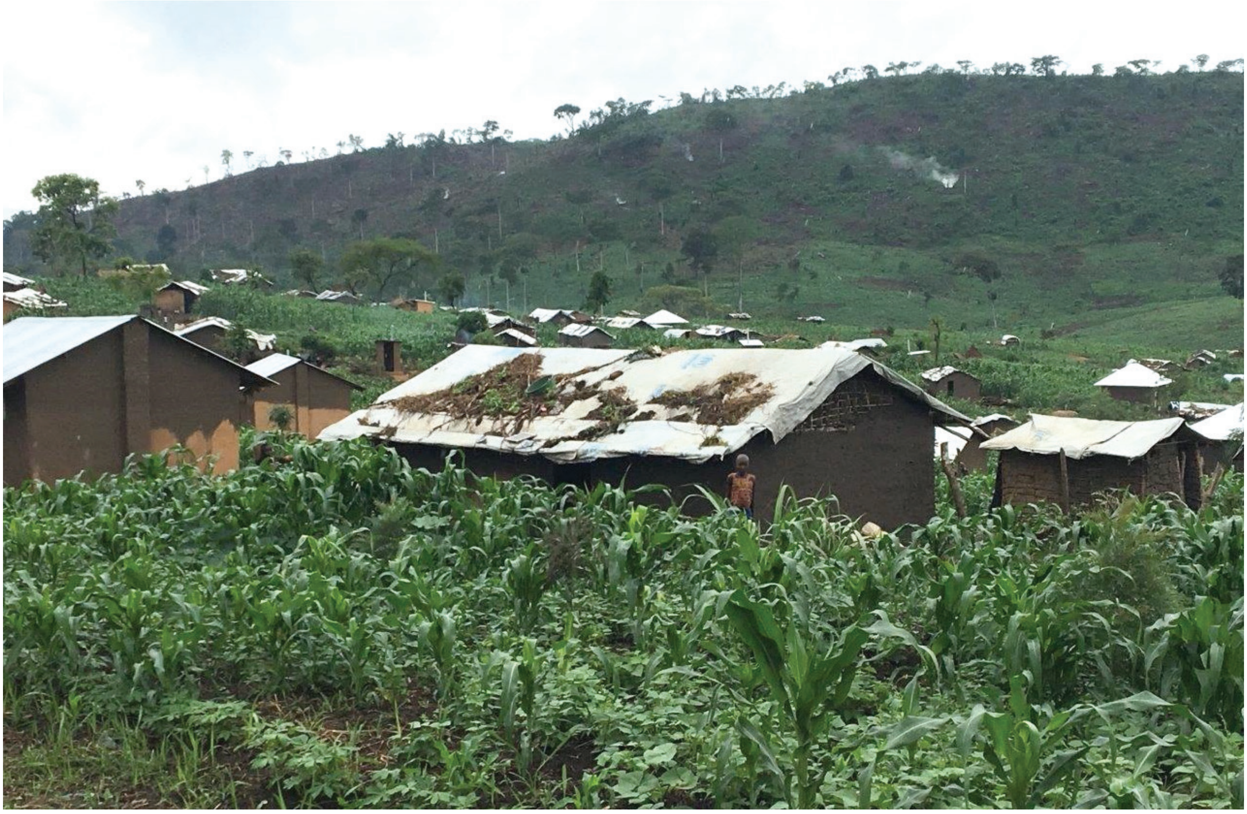
Figure 21. Biomass stock changes in Kyangwali settlement and 5 km and 15 km buffers (2000–2017)


Above ground biomass (AGB) stock change between 2000 and 2017
Kyangwali
0 2.25 4.5 9
Kilometers
1:168,620
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Tree cover loss
River / water bodies
AGB stock change (ton/ha)
-273 - -100
-99 - -10
-9 - 10
11 - 100
101 - 272
Democratic Republic of the Congo
Lake Albert
Kyangwali refugee settlement
Kyangwali
Kabwoya
Bugoma CFR
Rugashari
Kiryanga
Mabaale
Mpeefu
Kagadi
Muhoro
Bwikara
Kyanaisoke
Ruzaire CFR
Mugarama
Rwengara CWMA
Kanara
Rwebisengo
Toro-Semliki WR
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
1°20'0"N
1°15'0"N
1°10'0"N
1°5'0"N
1°0'0"N

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA; tree cover loss: Hansen et al. 2013.

According to UNHCR global guidelines, refugee settlements should be located at least at one day's walking distance from protected areas or reserves[24]. This is not the case with the Kyangwali settlement, which is adjacent to Bugoma CFR (Figure 22), Rwamwanja (adjacent to Katonga WR) and Kiryandongo (overlapping Kibeka CFR). Kyangwali covers 142 km^2 and the decision was made by the OPM to settle Congolese refugees who arrived in 2018 and 2019 in the blocks immediately next to Bugoma CFR, with foreseeable implications for high-value natural assets. The location of these refugee settlements near protected areas is not in line with Uganda's conservation priorities, nor does it align with UNHCR's global planning guidelines for refugee operations.

Figure 22. Refugee households at the edge of Bugoma CFR, with charcoal production activities and tree cover loss



© FAO/Arturo Gianvenuti

---

[24] emergency.unhcr.org/entry/45581/camp-planning-standards-planned-settlements

Fact sheet: Deforestation and forest degradation in Bugoma CFR in 2019

In response to the dramatic evidence of forest destruction at Bugoma CFR, the NFA, with the support of FAO, carried out an in-depth assessment of the extent and causes of deforestation and degradation.

Location

Bugoma CFR in Kikuube District, with 411 km^2 of protected area, is the largest remaining block of natural tropical forest along the Albertine Rift Valley. According to Plumptre et al. (2010), Bugoma CFR is home to about 500 chimpanzees (10 percent of the Ugandan chimpanzee population). Among other primates, Bugoma CFR hosts a population of Ugandan mangabeys, endemic to this forest and therefore a unique treasure. The bird list consists of 221 recorded species. Biodiversity surveys have recorded 224 species of trees and shrubs, which is more than in any other forest in the region. Furthermore, Bugoma CFR provides forest products and ecosystem services to the surrounding communities.

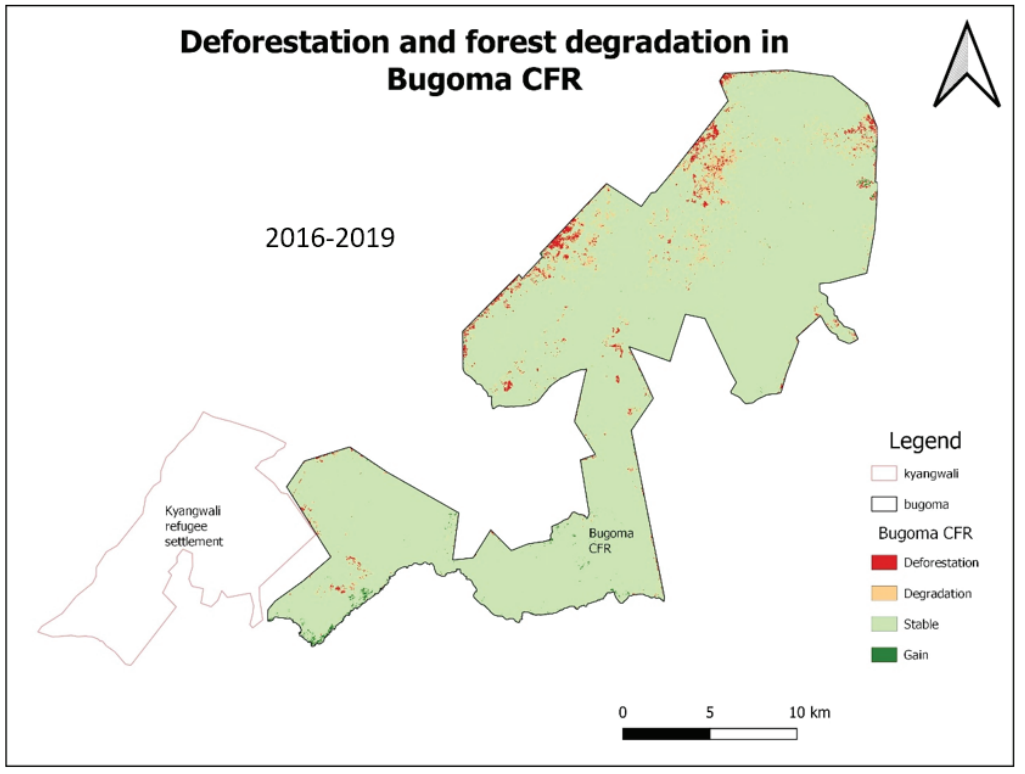
Results

Taking 2013 as the base year of assumed forest stability, the analysis shows the cumulative extent of deforestation and degradation within Bugoma CFR in 2016, 2018, and 2019. The results indicate an incremental trend, as shown in the following table:

	Area affected (ha)		
	2016	2018	2019
Deforestation	83	228	704
Forest degradation	66	306	1,186

Source: NFA

The results show a substantial increase in degradation and deforestation in 2019. The map below indicates that the main impact between 2016 and 2019 is located more than 15 km from the refugee settlement boundary. The settlement may have had local effects at the southwest edge of the forest but is clearly not the main cause of deforestation and forest degradation at Bugoma.



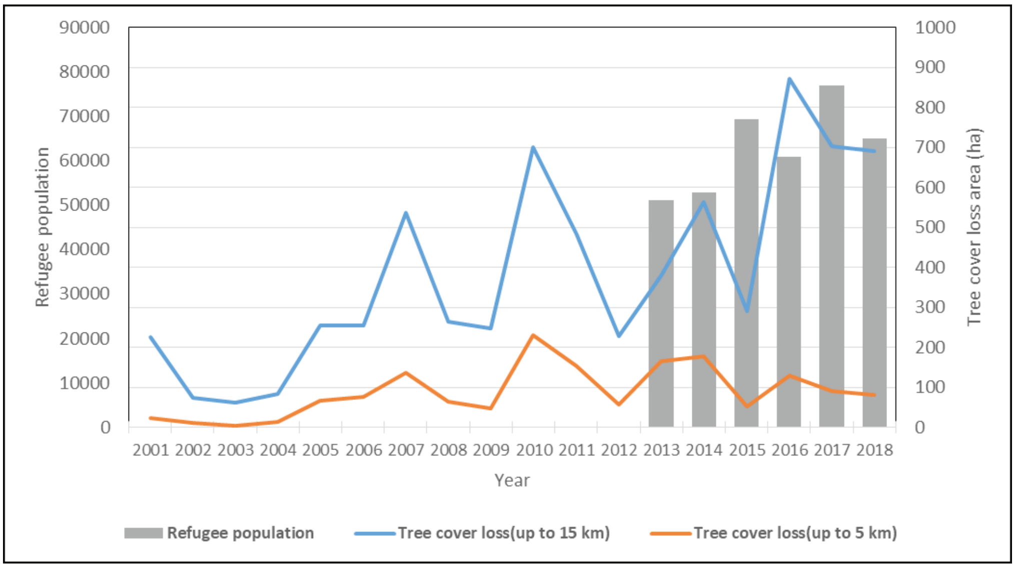
Source: NFA.

3.3 Rwamwanja settlement

Annual tree cover loss around Rwamwanja increased between 2001 and 2018, with peaks in 2007, 2010, 2014, and 2016 (Figure 23). It is noteworthy that there is no consistent link between tree cover loss and the presence of the refugees.

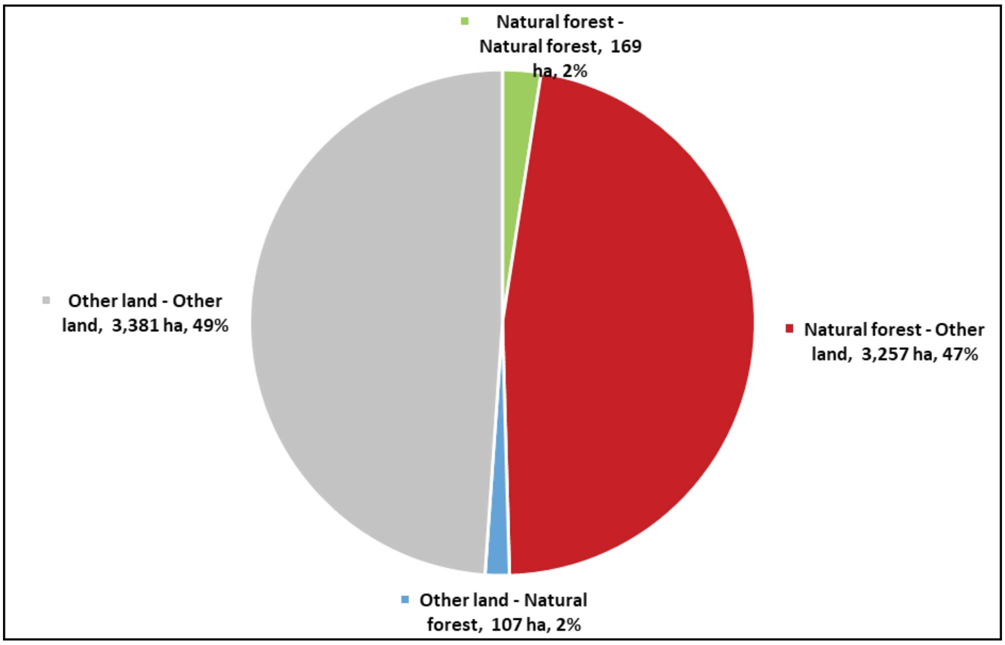
Within the 15 km buffer, 6,915 ha of tree cover was lost between 2001 and 2018, of which 49 percent and 47 percent occurred in transitions from stable 'other' land use and from natural forest to 'other' land use,[25] respectively (Figure 24).

Figure 23. Rwamwanja refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; refugee population: UNHCR.

Figure 24. Tree cover loss within LULC transition classes in Rwamwanja 15 km buffer (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; LULC: NFA.

---

[25] The THF, THFL, and Woodland categories of the national LULC map are considered as natural forest. The remaining classes are considered as other land (see 'Change detection' in Annex 1, Section B).

The highest concentrations of biomass in the Rwamwanja AoI are found within Katonga WR (Figure 25). Scattered tree cover loss over the whole AoI is observed (Figure 26), but there is no apparent link between the settlement location and the locations of greatest AGB loss. High biomass loss occurred north of the refugee settlement due to conversion of tropical high forest and woodland (Table 15 and Table 16). High biomass gain was meanwhile observed in the south, mostly within Katonga WR. From 2000 to 2017, net biomass changes were −4 percent and −7 percent within the 5 km and 15 km buffers, respectively.

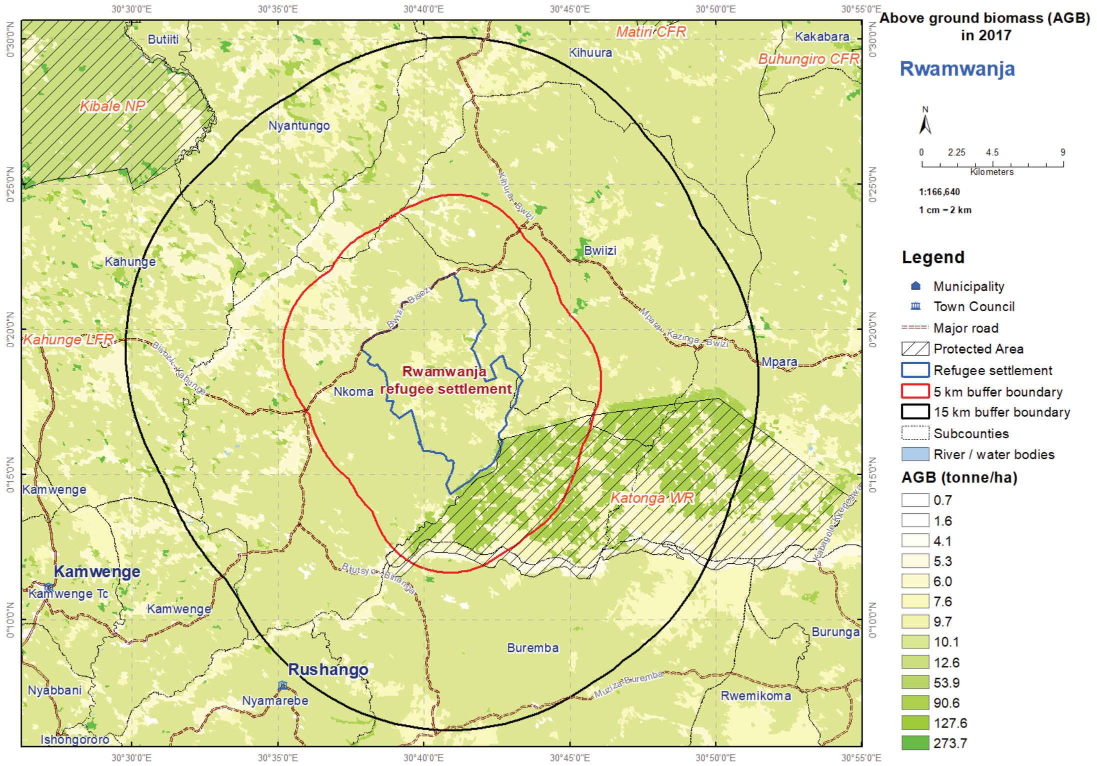
Table 15. Changes in LULC and biomass stock in Rwamwanja 5 km buffer (2000-2017)

LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	0	61	61	0	248	248	
Bushland	5,959	3,641	−2,318	45,445	27,763	−17,682	−39
Commercial farmland	0	0	0	0	0	0	
Grassland	1,064	2,903	1,839	5,654	15,432	9,778	173
Impediment (bare soil, bare rock, and so on)	0	0	0	0	0	0	—
Plantations, broad-leaved	0	13	13	0	1,151	1,151	—
Plantations, coniferous	0	10	10	0	515	515	—
Subsistence farmland	13,194	23,110	9,916	133,372	233,605	100,233	75
THF	374	474	100	47,700	60,504	12,804	27
THFL	0	0	0	0	0	0	—
Water	0	0	0	0	0	0	—
Wetland	310	364	54	494	581	87	18
Woodland	12,866	3,191	−9,675	162,649	40,341	−122,308	−75
				395,314	**380,140**	**−15,174**	**−4**

Table 16. Changes in LULC and biomass stock in Rwamwanja 15 km buffer (2000-2017)

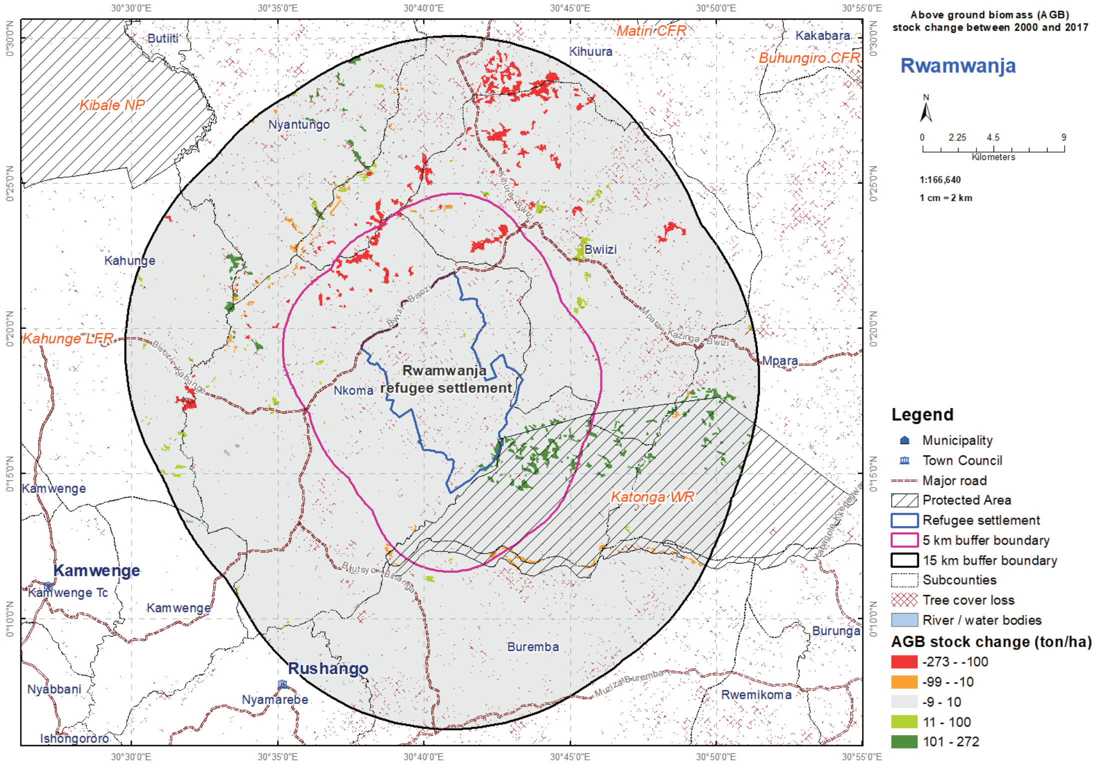
LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–-2017 (%)
Built-up areas	0	403	403	0	1,639	1,639	
Bushland	14,519	12,782	−1,737	110,722	97,472	−13,250	−12
Commercial farmland	0	0	0	0	0	0	
Grassland	8,687	12,403	3,716	46,172	65,929	19,757	43
Impediment (bare soil, bare rock, and so on)	0	0	0	0	0	0	—
Plantations, broad-leaved	0	323	323	0	29,286	29,286	—
Plantations, coniferous	0	43	43	0	2,344	2,344	—
Subsistence farmland	70,755	92,050	21,295	715,222	930,467	215,245	30
THF	1,464	1,092	−372	186,759	139,378	−47,381	−25
THFL	62	30	−32	17,060	8,339	−8,721	−51
Water	0	19	19	0	0	0	—
Wetland	2,587	2,866	279	4,128	4,573	445	11
Woodland	34,216	10,278	−23,938	432,559	129,936	−302,623	−70
				1,512,622	**1,409,363**	**−103,259**	**−7**

Figure 25. Biomass stock in Rwamwanja settlement and 5 km and 15 km buffers (2017)


Above ground biomass (AGB) in 2017
Rwamwanja
N
0 2.25 4.5 9
Kilometers
1:166,640
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
AGB (tonne/ha)
0.7
1.6
4.1
5.3
6.0
7.6
9.7
10.1
12.6
53.9
90.6
127.6
273.7
30°30'0"E
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
0°10'0"N
Butiiti
Matiri CFR
Kihuura
Kakabara
Buhungiro CFR
Kibale NP
Nyantungo
Bwiizi
Kahunge
Kahunge LFR
Mpara
Rwamwanja refugee settlement
Nkoma
Kamwenge
Katonga WR
Kamwenge Tc
Buremba
Burunga
Rushango
Nyabbani
Nyamarebe
Rwemikoma
Ishongororo

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA.

Figure 26. Biomass stock changes in Rwamwanja settlement and 5 km and 15 km buffers (2000–2017)

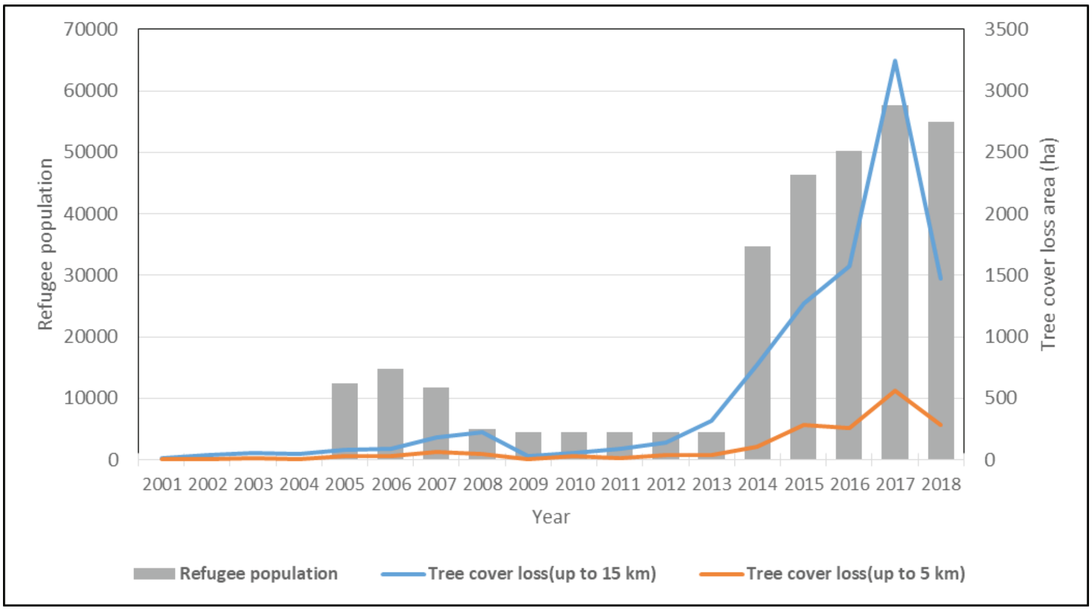

Above ground biomass (AGB) stock change between 2000 and 2017
Rwamwanja
N
0 2.25 4.5 9
Kilometers
1:166,640
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Tree cover loss
River / water bodies
AGB stock change (ton/ha)
-273 - -100
-99 - -10
-9 - 10
11 - 100
101 - 272
30°30'0"E
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
0°10'0"N
Butiiti
Matiri CFR
Kihuura
Kakabara
Buhungiro CFR
Kibale NP
Nyantungo
Bwiizi
Kahunge
Kahunge LFR
Mpara
Rwamwanja refugee settlement
Nkoma
Kamwenge
Katonga WR
Kamwenge Tc
Buremba
Burunga
Rushango
Nyabbani
Nyamarebe
Rwemikoma
Ishongororo

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA; tree cover loss: Hansen et al. 2013.

3.4 Kiryandongo settlement

After a period of low and stable rates of annual tree cover loss around Kiryandongo between 2001 and 2012, a significant increase in the area of tree cover lost each year was observed from 2013 to 2017, corresponding with a period when the refugee population rose nearly tenfold (Figure 27). This was followed by a surprising fall in the annual tree cover loss in 2018, perhaps because the area opened up for incoming refugees had then stabilized.

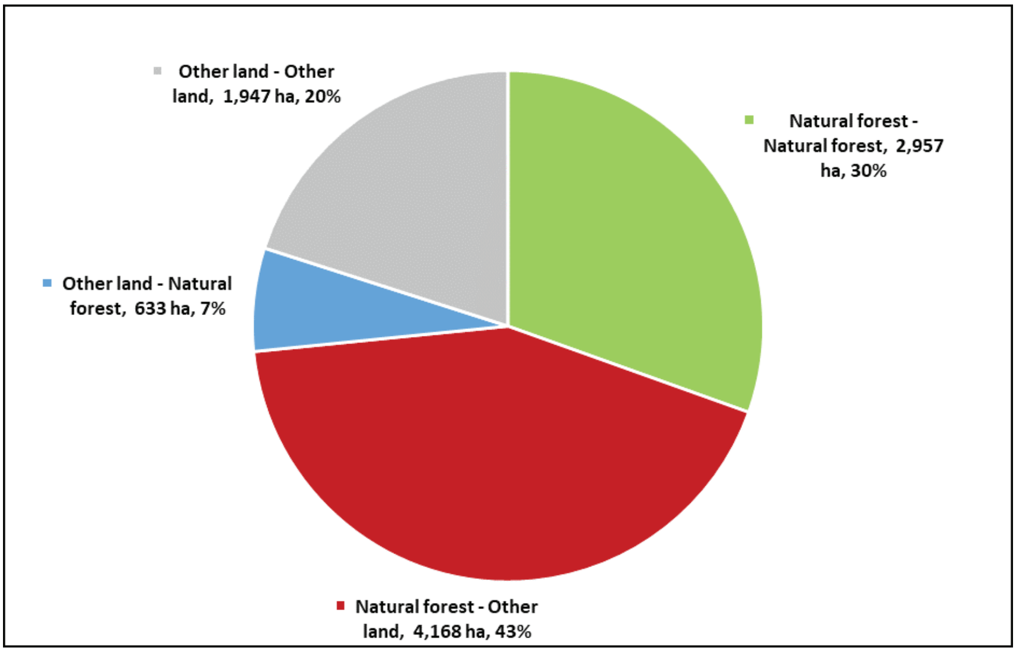
Figure 27. Kiryandongo refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; refugee population: UNHCR.

Within the 15 km buffer, 9,705 ha of tree cover was lost between 2001 and 2018, of which 43 percent represented a transition from natural forest to other land. About 30 percent of the tree cover loss occurred in permanent forest, that is, forest remaining forest but becoming degraded, as shown in Figure 28.

Figure 28. Tree cover loss within LULC transition classes in Kiryandongo 15 km buffer (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; LULC: NFA.

Loss of AGB[26] in the Kiryandongo AoI since 2000 has mainly been associated with the conversion of woodland and bushland to other low-stock LULC classes (Table 17 and Table 18) (data sources in Annex 1, Section B). Some scattered gains of biomass were also observed (Figure 30), primarily due to the conversion of sparsely stocked bushland and grassland to subsistence farmland. From 2000 to 2017, net biomass changes were 0 and −1 percent in the 5 km and 15 km buffer areas, respectively. This illustrates negligible net change in biomass stocking, through a significant change in LULC from bushland and woodland to grassland was observed within 5 km, and to farmland and built-up area in the 15 km buffer.

Table 17. Changes in LULC and biomass stock in Kiryandongo 5 km buffer (2000-2017)

LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000-2017 (%)
Built-up areas	0	282	282	0	1,147	1,147	—
Bushland	7,480	3,778	−3,702	57,040	28,813	−28,227	−49
Commercial farmland	0	1,647	1,647	0	16,651	16,651	—
Grassland	45	123	78	239	656	417	174
Impediment (bare soil, bare rock, and so on)	0	0	0	0	0	0	—
Plantations, broad-leaved	0	19	19	0	1,754	1,754	—
Plantations, coniferous	0	48	48	0	2,569	2,569	—
Subsistence farmland	13,996	18,789	4,793	141,471	189,929	48,458	34
THF	0	0	0	0	0	0	—
THFL	0	0	0	0	0	0	—
Water	0	0	0	0	0	0	—
Wetland	0	158	158	0	253	253	—
Woodland	5,735	2,409	−3,326	72,497	30,457	−42,040	−58
				271,247	**272,229**	**982**	**0**

Table 18. Changes in LULC and biomass stock in Kiryandongo 15 km buffer (2000-2017)

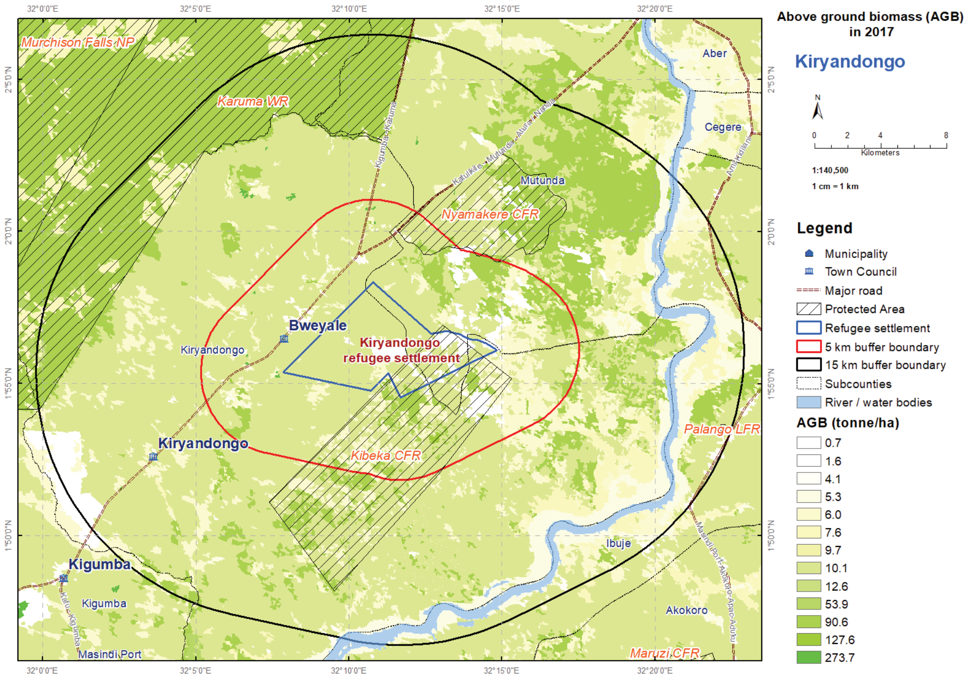
LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–-2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000–2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	34	603	569	137	2,452	2,315	1,690
Bushland	18,046	11,371	−6,675	137,611	86,709	−50,902	−37
Commercial farmland	235	2,813	2,578	2,375	28,430	26,055	1,097
Grassland	946	4,556	3,610	5,026	24,217	19,191	382
Impediment (bare soil, bare rock, and so on)	0	1	1	0	1	1	—
Plantations, broad-leaved	0	65	65	0	5,937	5,937	—
Plantations, coniferous	0	75	75	0	4,065	4,065	—
Subsistence farmland	48,338	67,562	19,224	488,612	682,943	194,331	40
THF	0	115	115	0	14,649	14,649	—
THFL	0	45	45	0	12,371	12,371	—
Water	2,431	2,592	161	0	0	0	—
Wetland	6,066	5,469	−597	9,678	8,726	−952	−10
Woodland	44,043	24,869	−19,174	556,789	314,389	−242,400	−44
				1,200,228	**1,184,889**	**−15,339**	**−1**

---

[26] AGB expressed in dry weight.

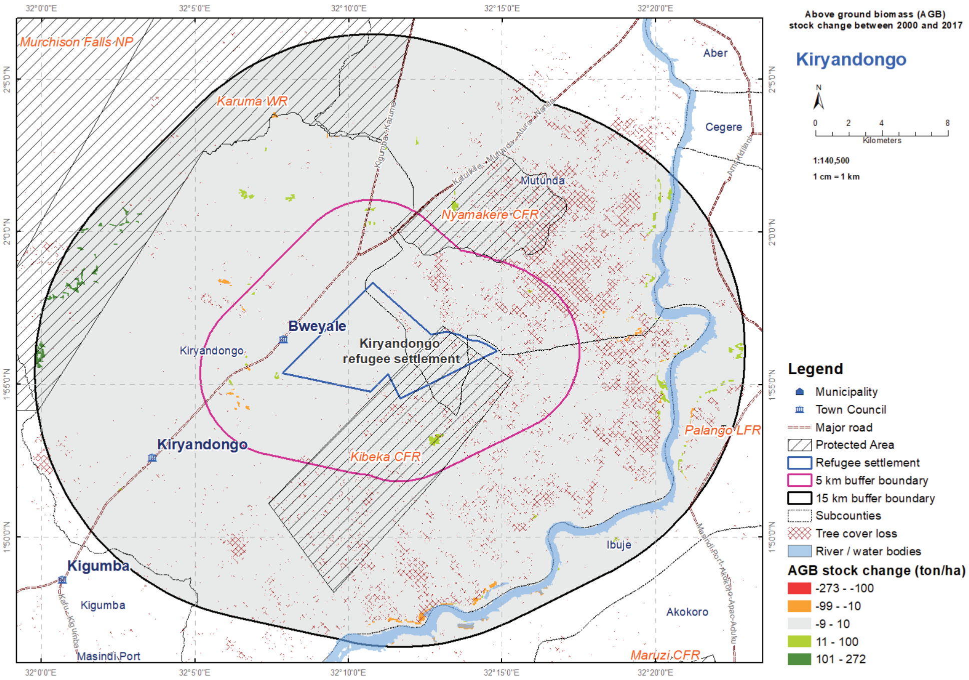
The Kiryandongo AoI impinges on three protected areas: Kibeka CFR partly overlaps the settlement, Nyamakere CFR falls fully inside the 15 km buffer zone, and Karuma WR partly overlaps the 15 km buffer. These protected areas were all established before Kiryandongo refugee settlement[27]. High concentrations of biomass were observed in these three areas, particularly in Karuma WR (Figure 29). The spatial distribution of tree cover loss mainly occurred in the eastern part of the buffer zone (Figure 30).

Figure 29. Biomass stock in Kiryandongo settlement and 5 km and 15 km buffers (2017)


Above ground biomass (AGB) in 2017
Kiryandongo
Murchison Falls NP
Karuma WR
Nyamakere CFR
Kibeka CFR
Palango LFR
Maruzi CFR
Mutunda
Aber
Cegere
Bweyale
Kiryandongo refugee settlement
Kiryandongo
Kigumba
Ibuje
Akokoro
Masindi Port
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
AGB (tonne/ha)
0.7
1.6
4.1
5.3
6.0
7.6
9.7
10.1
12.6
53.9
90.6
127.6
273.7
1:140,500
1 cm = 1 km
Kilometers

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA.

Figure 30. Biomass stock changes in Kiryandongo settlement and 5 km and 15 km buffers (2000–2017)


Above ground biomass (AGB) stock change between 2000 and 2017
Kiryandongo
Murchison Falls NP
Karuma WR
Nyamakere CFR
Kibeka CFR
Palango LFR
Maruzi CFR
Bweyale
Kiryandongo refugee settlement
Kigumba
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Tree cover loss
River / water bodies
AGB stock change (ton/ha)
-273 - -100
-99 - -10
-9 - 10
11 - 100
101 - 272

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA; tree cover loss: Hansen et al. 2013.

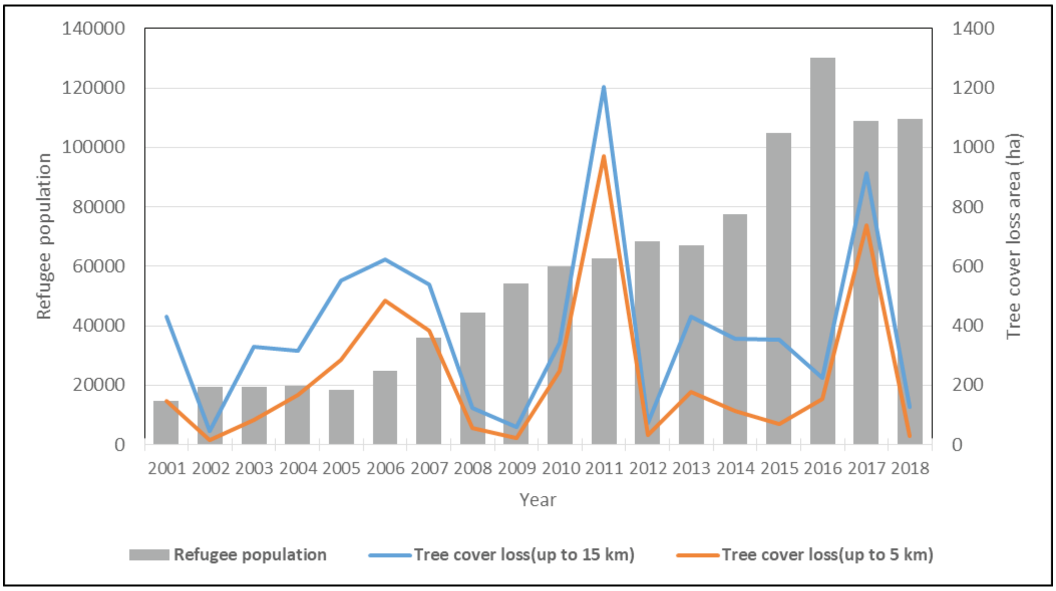
---

[27] Kibeka and Nyamakere were established in 1948; Karuma in 1964; and the Kiryandongo settlement in 1990.

3.5 Nakivale and Oruchinga settlements

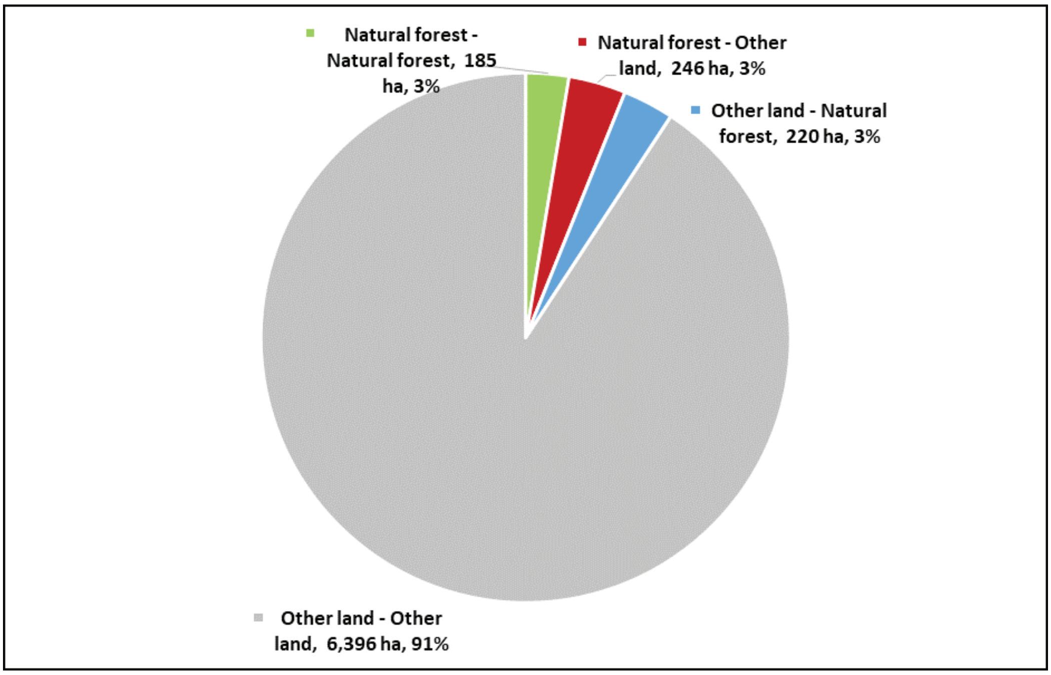
Three major peaks of tree cover loss were detected around the merged Nakivale-Orichinga AoI, in 2006, 2011, and 2017 (Figure 31), with a higher percentage of loss in the 5 km buffer zone. It is interesting to note that these three spikes in tree cover loss correspond with three peaks of rainfall in the same years (see Annex 3). This suggests that tree cover loss within the 5 km and 15 km buffers might be related to the clearing of land for expansion of farming during favorable weather conditions. There is no evidence of any correlation between tree cover loss and increasing refugee population. Within the 15 km buffer, about 7,047 ha of tree cover was lost between 2001 and 2018. Most of this loss (about 91 percent) occurred in stable 'other' land[28] (Figure 32), which means clearing of remnant trees in land that was already non-forest.

Figure 31. Nakivale and Oruchinga refugee population and annual tree cover loss in 5 km and 15 km buffers (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; refugee population: UNHCR.

Figure 32. Tree cover loss within LULC transition classes in Nakivale and Oruchinga 15 km buffer (2001–2018)



Source: Tree cover loss: Hansen et al. 2013; LULC: NFA.

---

[28] 'Other land' indicates the lands other than natural forest, as explained in Annex 1, Section B.

Lake Mburo NP and Kyalwamuka CFR partly fall within this AoI. Moderate concentration of biomass was observed to the north of the refugee settlements, mostly within Lake Mburo NP (Figure 33). Scattered tree cover loss is observed in this AoI, with moderate gain and loss of biomass scattered all over the AoI (Figure 34). Biomass changes were mainly due to significant loss of bushland in favor of grassland and subsistence farmland (Table 19 and Table 20). From 2000 to 2017, net biomass changes were –4 percent and –7 percent in the 5 km and 15 km buffer areas, respectively. This represents minimal loss and a pattern of more loss further away from the settlements than close to them.

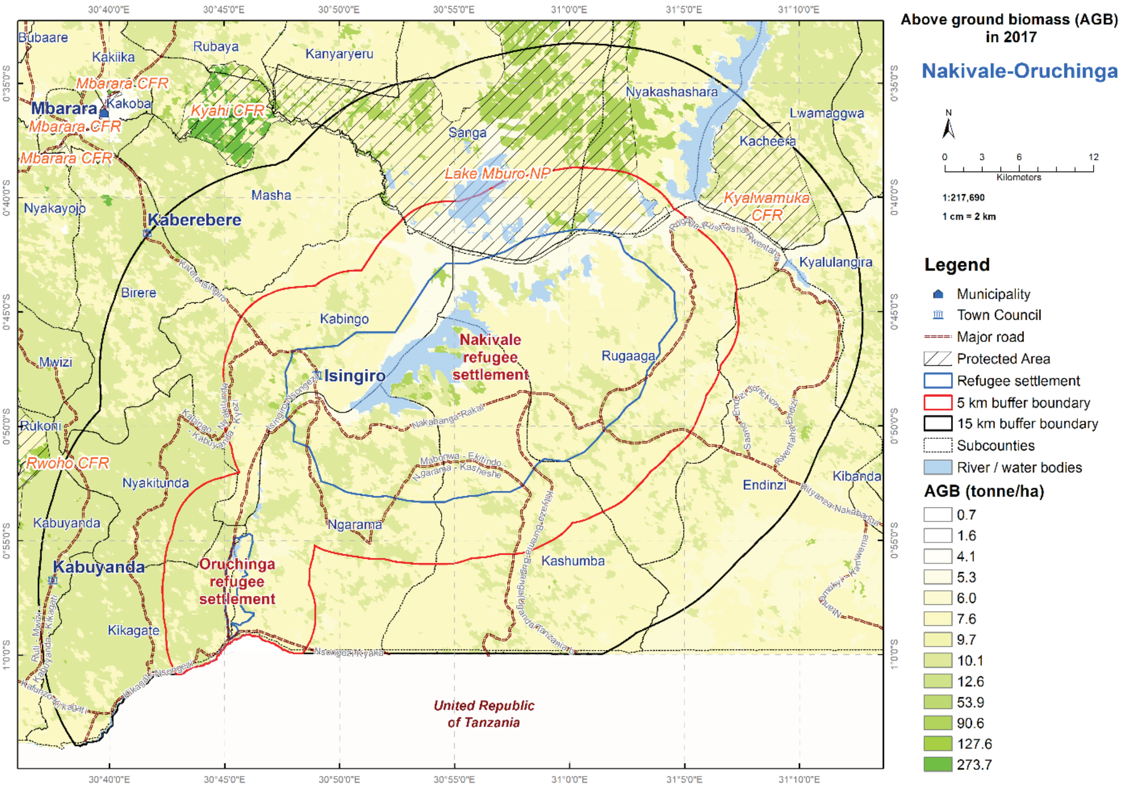
Table 19. Changes in LULC and biomass stock in Nakivale and Oruchinga 5 km buffer (2000-2017)

LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000-2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000-2017 (t)	AGB stock change 2000-2017 (%)
Built-up areas	0	24	24	0	99	99	
Bushland	25,852	3,739	–22,113	197,138	28,515	–168,623	–86
Commercial farmland	0	0	0	0	0	0	
Grassland	50,104	64,200	14,096	266,322	341,247	74,925	28
Impediment (bare soil, bare rock, and so on)	0	3	3	0	2	2	—
Plantations, broad-leaved	0	0	0	0	0	0	—
Plantations, coniferous	0	0	0	0	0	0	—
Subsistence farmland	18,544	24,367	5,823	187,445	246,311	58,866	31
THF	0	0	0	0	0	0	—
THFL	0	0	0	0	0	0	—
Water	4,359	4,827	468	0	0	0	—
Wetland	11,388	12,722	1,334	18,170	20,299	2,129	12
Woodland	777	1,140	363	9,820	14,415	4,595	47
				678,895	**650,888**	**–28,007**	**–4**

Table 20. Changes in LULC and biomass stock in Nakivale and Oruchinga 15 km buffer (2000-2017)

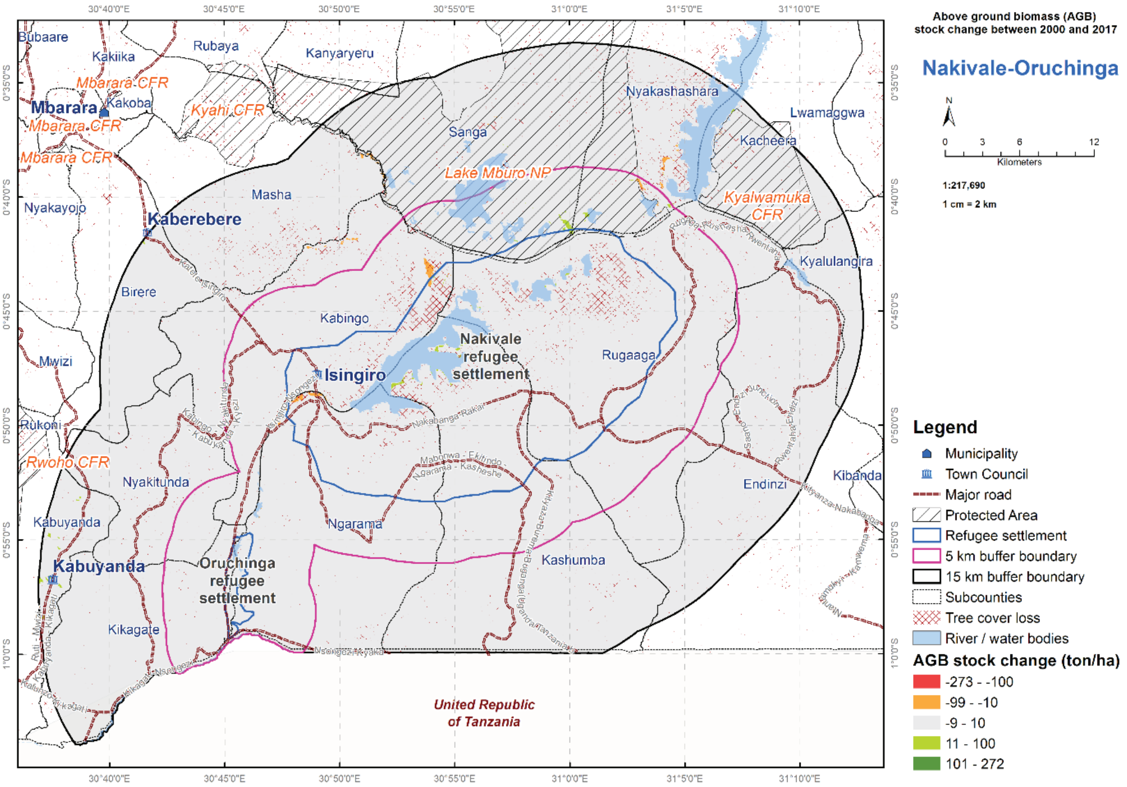
LULC class	Area in 2000 (ha)	Area in 2017 (ha)	Area change 2000–2017 (ha)	AGB in 2000 (t)	AGB in 2017 (t)	AGB stock change 2000-2017 (t)	AGB stock change 2000–2017 (%)
Built-up areas	0	80	80	0	327	327	
Bushland	57,996	12,145	–45,851	442,258	92,613	–349,645	–79
Commercial farmland	0	0	0	0	0	0	
Grassland	99,188	144,556	45,368	527,221	768,368	241,147	46
Impediment (bare soil, bare rock, and so on)	0	25	25	0	17	17	—
Plantations, broad-leaved	0	11	11	0	997	997	—
Plantations, coniferous	0	57	57	0	3,053	3,053	—
Subsistence farmland	70,711	67,612	–3,099	714,765	683,449	–31,316	–4
THF	0	0	0	0	0	0	—
THFL	0	0	0	0	0	0	—
Water	7,277	7,960	683	0	0	0	9
Wetland	14,459	16,431	1,972	23,071	26,217	3,146	14
Woodland	8,552	9,304	752	108,107	117,627	9,520	9
				1,815,422	**1,692,668**	**–122,754**	**–7**

Figure 33. Biomass stock in Nakivale and Oruchinga settlements and 5 km and 15 km buffers (2017)


Above ground biomass (AGB) in 2017
Nakivale-Oruchinga
N
0 3 6 12
Kilometers
1:217,690
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
AGB (tonne/ha)
0.7
1.6
4.1
5.3
6.0
7.6
9.7
10.1
12.6
53.9
90.6
127.6
273.7
Bubaare
Kakiika
Rubaya
Kanyaryeru
Mbarara CFR
Mbarara
Kakoba
Kyahi CFR
Nyakashashara
Lwamaggwa
Sanga
Kacheera
Lake Mburo NP
Masha
Kyalwamuka CFR
Nyakayojo
Kaberebere
Kyalulangira
Birere
Kabingo
Nakivale refugee settlement
Rugaaga
Mwizi
Isingiro
Rukoni
Rwoho CFR
Nyakitunda
Endinzi
Kibanda
Kabuyanda
Ngarama
Kashumba
Oruchinga refugee settlement
Kikagate
United Republic of Tanzania
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
0°35'0"S
0°40'0"S
0°45'0"S
0°50'0"S
0°55'0"S
1°0'0"S

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA.

Figure 34. Biomass stock changes in Nakivale and Oruchinga settlements and 5 km and 15 km buffers (2000-2017)


Above ground biomass (AGB) stock change between 2000 and 2017
Nakivale-Oruchinga
N
0 3 6 12
Kilometers
1:217,690
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Tree cover loss
River / water bodies
AGB stock change (ton/ha)
-273 - -100
-99 - -10
-9 - 10
11 - 100
101 - 272
Bubaare
Kakiika
Rubaya
Kanyaryeru
Mbarara CFR
Mbarara
Kakoba
Kyahi CFR
Nyakashashara
Lwamaggwa
Sanga
Kacheera
Lake Mburo NP
Masha
Kyalwamuka CFR
Nyakayojo
Kaberebere
Kyalulangira
Birere
Kabingo
Nakivale refugee settlement
Rugaaga
Mwizi
Isingiro
Rukoni
Rwoho CFR
Nyakitunda
Endinzi
Kibanda
Kabuyanda
Ngarama
Kashumba
Oruchinga refugee settlement
Kikagate
United Republic of Tanzania
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
0°35'0"S
0°40'0"S
0°45'0"S
0°50'0"S
0°55'0"S
1°0'0"S

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC and AGB: NFA; tree cover loss: Hansen et al. 2013.

4 LINKING WOODFUEL DEMAND AND POTENTIAL SUPPLY

Estimated figures for woodfuel demand and potential supply for each refugee settlement are shown in Table 21. Charcoal demand has been quoted in ‘firewood-equivalent’ assuming a conversion efficiency of 20 percent. The estimation of woody biomass resources available for woodfuel supply takes into account AGB stock and annual growth, including all forest classes (except coniferous plantations, because these make inferior fuel) and non-forest classes (bushland, grassland, subsistence farmland, and built-up areas) within 5 km of the settlement boundaries. Estimated woodfuel demand is derived from average household consumption data from this survey, based on October 2019 refugee populations and local populations projected to 2019 from the 2014 census.

The woodfuel consumption figures for each location are averages extrapolated from the household survey data in Table 6 for the two surveyed AoIs: Kyaka II in Kyegegwa District and Kyangwali in Kikuube District. The Kyaka II consumption data is extended to Rwamwanja and the Kyangwali figures to Kiryandongo, as they are in the same agro-ecological zones. This is a methodological limitation necessitated by the lack of site-specific survey at Rwamwanja and Kiryandongo. No data were extrapolated to Nakivale and Oruchinga, these being in a quite different social and ecological context (see Figure 37).

Based on the combined population of refugees and host communities within the 5 km buffer zone of the four western refugee settlements (of which refugees and hosts account for 59 and 41 percent, respectively), total estimated woodfuel consumption is 475,130 t per year (Table 21). Meanwhile, the total estimated AGB stock within the same zones is 2,521,426 t with an annual increment of 194,039 t. Taking into account only the woody biomass from the 5 km buffer zones and assuming that woodfuel demand is met only with this biomass, there is therefore an annual deficit equivalent to 11 percent of AGB stock. If biomass within protected areas was excluded, the deficit would be higher.

Table 21. Estimated woodfuel demand and potential supply within target refugee settlements and 5 km buffer

AoI	Refugee population (October 2019)	Refugee woodfuel consumption (kg pppd)	Host population within 5 km (2019)	Host woodfuel consumption (kg pppd)	Combined woodfuel demand (t/yr)	AGB stock (t)	AGB growth (t/yr)	AGB loss (t/yr)	Annual net loss (%)
Kiryandongo	63,365	2.25	52,950	2.13	93,261	272,229	29,384	63,877	-23
Kyaka II	113,023	2.14	61,004	1.85	129,336	432,578	39,394	89,942	-21
Kyangwali	115,488	2.25	90,308	2.13	165,161	1,436,480	83,300	81,861	-6
Rwamwanja	70.493	2.14	48,000	1.85	87,371	380,139	41,961	45,410	-12
Total	**362,369**		**252,262**		**475,130**	**2,521,426**	**194,039**	**281,091**	**-11**

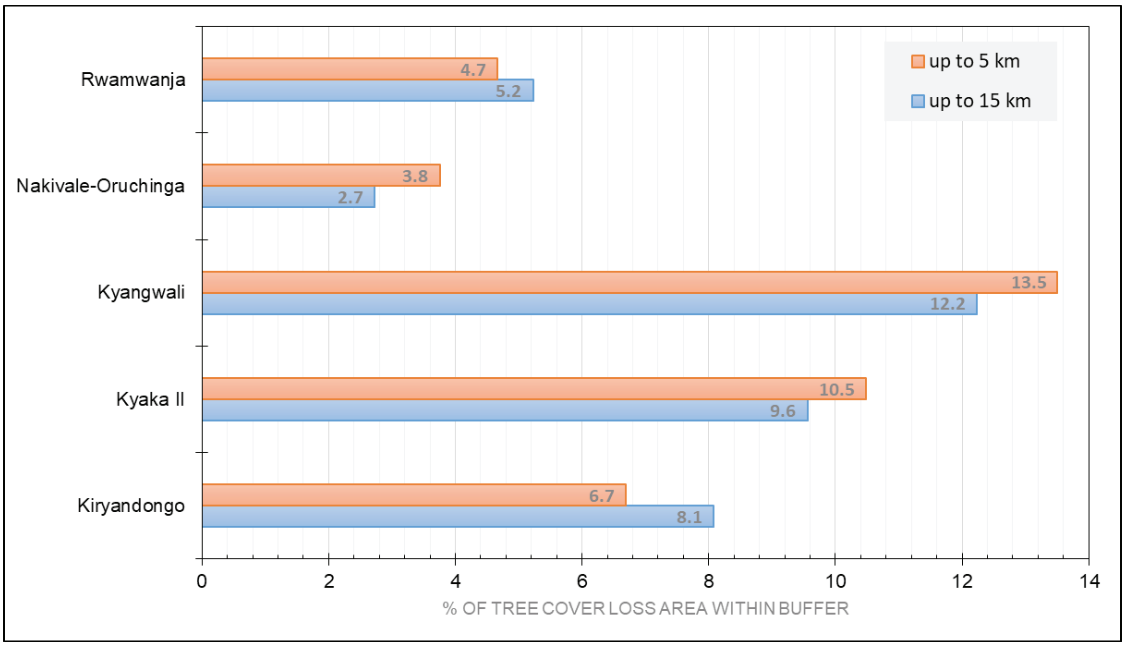
Sources: Refugee population data (refugees and asylum seekers): OPM/UNHCR; host population: WorldPop 2019 (based on UBOS data).

Note: AGB estimated on a dry basis and includes the biomass of the settlements themselves. Woodfuel demand was converted to dry basis assuming 18 percent moisture content of firewood, using the original data (Table 6). AGB growth rates from the National Biomass Study (NBS) (Forest Department 2002) as national averages, converted from air-dry to dry basis assuming the same 18 percent moisture content.

The tree cover loss detected from 2001 to 2018 (Figure 35) and the biomass stock loss from 2000 to 2017 (Figure 36) confirm that depletion is occurring at various distances from the settlements in all the target AoIs. The summary of tree cover loss in Figure 35 shows that in Kyaka II, Kyangwali, and Nakivale-Oruchinga, tree cover loss was more concentrated in the 5 km buffer than the 15 km buffer, while at Rwanwanja and Kiryandongo the opposite was the case. In Kyaka II and Kyangwali, the overall tree cover loss over 2001–2018 was close to or greater than 10–13 percent in both the 5 km and 15 km buffers. The lowest tree cover loss, in terms of percentage area, was observed in the Nakivale-Oruchinga AoI, where the presence of trees was already comparatively low.

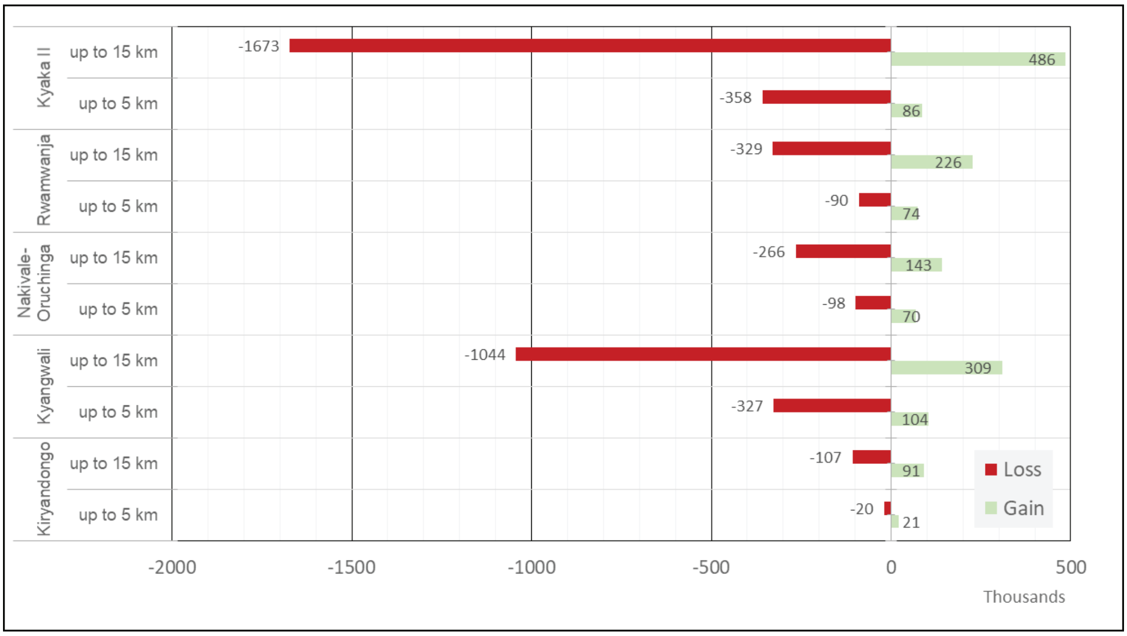
Among the target AoIs, the highest loss[29] of biomass between 2000 and 2017 occurred within 15 km of the Kyaka II settlement boundary (about 1,673,000 t), followed by Kyangwali (about 1,044,000 t), as shown in Figure 36. Within the 5 km buffer, biomass loss was also highest at Kyaka II (about 358,000 t) and Kyangwali (about 327,000 t). A net gain in biomass was observed only within the 5 km buffer of the Kiryandongo settlement, taking into account the LULC change from 2000 to 2017.

Figure 35. Summary of tree cover loss from across buffers in the AoIs (2001-2018)



Source: Tree cover loss: Hansen et al. 2013.

Figure 36. Summary of AGB stock changes across buffers in the AoIs (2000-2017)



Note: Loss/gain is associated with LULC changes. For example, if there was a change from higher stock LULC to lower stock LULC, then there was loss of biomass and vice versa. Both of these transitions were found in all buffer zones and respective loss/gain was estimated accordingly.

---

[29] Loss of biomass refers to reduction of biomass stock due to change from higher stock LULC class to lower stock LULC class, and vice versa for gain.

It is important to note that the results of the analysis of tree cover loss and LULC changes do not always reflect the losses of AGB that would be expected based on the estimated woodfuel demand of refugee and host communities living up to 5 km from the settlement boundaries. In other words, the expected 11 percent loss of AGB stock expected within the 5 km buffers based on the woodfuel consumption data is not in fact fully observed in the extent of the observed tree cover loss and LULC changes. In addition, it is important to note that biomass stock and changes also target the protected areas within the AOIs. For instance, according to the woodfuel demand and supply data presented in Table 21, the Kiryandongo AoI shows a high rate of annual net tree cover loss that does not correspond to an equally high rate of AGB stock change (Figure 35 and Figure 36). This can perhaps be explained by partial supply of woodfuel (especially charcoal) from other areas. Kiryandongo, for example, lies close to two major towns and the Kampala-Gulu highway, which facilitates access to a wider energy supply zone for those refugees and Ugandans who are able to purchase some of their fuel. It is also possible that there is absenteeism among both the refugee and host communities, meaning that neither the refugee headcount nor the population census data are accurate reflections of the number of people actually present within the settlements and buffer zones at any time. The complexities of these dynamics require site-specific analysis.

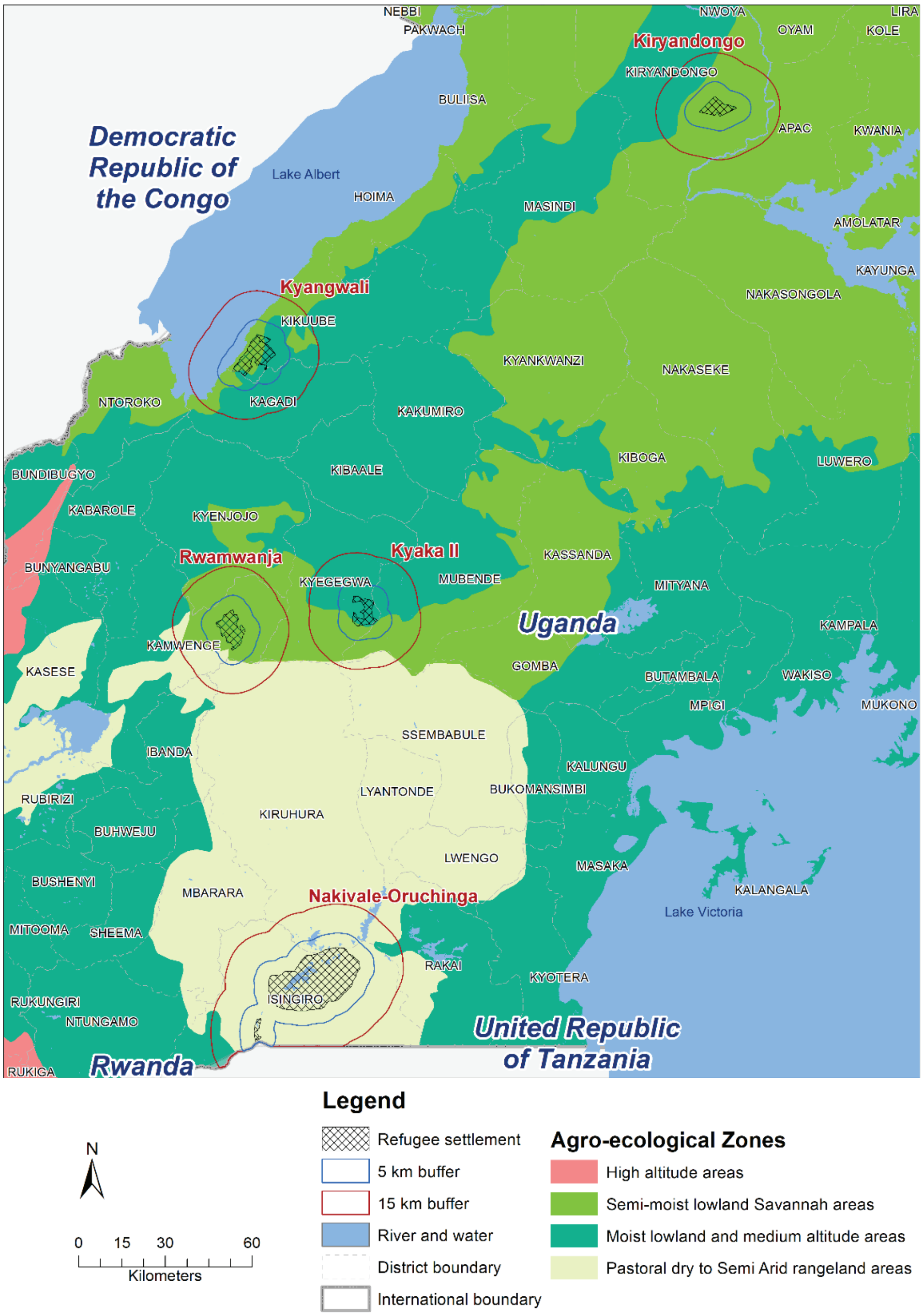
On the other hand, the comparison between supply and demand for Kyangwali shows a relatively low rate of annual biomass loss (6 percent) (Table 21), yet the tree cover loss and biomass stock change findings show consistent areas of degradation. This could be explained by the presence of Bugoma CFR, which is covered by THF with a high biomass stock and annual growth that minimize the annual biomass loss. Such a biologically-rich forest should not be used as a resource to meet household energy needs, however. Rather, it should be better protected and alternative sources of cooking fuel and building material provided.

It is also important to note that field observations highlighted numerous other demands for forest products for construction, energy for commercial and economic activities, agricultural activities, and losses to fire, which further contribute to overall demand for woody biomass and which are not included in the calculations in this report.

5 RECOMMENDED TECHNICAL INTERVENTIONS

The refugee settlements are located in different agroecological zones (Figure 37), each characterized by a unique combination of soils, climatic conditions (see Annexes 3 and 4), and ecological factors that influence the management of forest resources and systems under which trees and crops are grown. A locally adapted package of forestry interventions is therefore proposed to fit the local biophysical characteristics that influence the selection of tree species, the yield potentialities of different trees or crops, and the suitability for optimizing land use.

Figure 37. Agroecological zones


NEBBI
PAKWACH
NWOYA
LIRA
Kiryandongo
OYAM
KOLE
KIRYANDONGO
BULIISA
APAC
KWANIA
Democratic Republic of the Congo
Lake Albert
HOIMA
MASINDI
AMOLATAR
KAYUNGA
Kyangwali
NAKASONGOLA
KIKUUBE
KYANKWANZI
NAKASEKE
NTOROKO
KAGADI
KAKUMIRO
KIBOGA
LUWERO
BUNDIBUGYO
KIBAALE
KABAROLE
KYENJOJO
Rwamwanja
Kyaka II
KASSANDA
BUNYANGABU
KYEGEGWA
MUBENDE
MITYANA
Uganda
KAMWENGE
KAMPALA
KASESE
GOMBA
BUTAMBALA
WAKISO
MPIGI
MUKONO
SSEMBABULE
IBANDA
KALUNGU
LYANTONDE
BUKOMANSIMBI
RUBIRIZI
KIRUHURA
BUHWEJU
LWENGO
MASAKA
BUSHENYI
MBARARA
Nakivale-Oruchinga
KALANGALA
Lake Victoria
MITOOMA
SHEEMA
RAKAI
KYOTERA
ISINGIRO
RUKUNGIRI
NTUNGAMO
United Republic of Tanzania
RUKIGA
Rwanda
N
0 15 30 60
Kilometers
Legend
Refugee settlement
5 km buffer
15 km buffer
River and water
District boundary
International boundary
Agro-ecological Zones
High altitude areas
Semi-moist lowland Savannah areas
Moist lowland and medium altitude areas
Pastoral dry to Semi Arid rangeland areas

Source: Agroecological zones: Forest Department 2002.

Demand for woodfuel is expected to increase with rising population, as other energy options for cooking are unavailable, unaffordable, or deliver inferior performance. This could increase the imbalance between demand and sustainable supply, placing growing strains on the wellbeing of both hosts and refugees, and potentially contributing to ongoing environmental deterioration in the refugee-hosting areas.

The harvesting of wood as a source of energy represents only one of several drivers of forest degradation[30] and deforestation[31]. These drivers are not exclusive, occur concurrently, and are mutually reinforcing. Based on the field observations in the AoI of the Kyaka II and Kyangwali settlements, the major drivers of forest degradation and deforestation in the buffer areas are the expansion of commercial and subsistence farming into forest land; the harvesting of forest products, mainly for charcoal, firewood, and timber; and the expansion of settlements, including refugee settlements. This is typical of the whole country, where the underlying drivers of deforestation and forest degradation are related to population growth, poverty, low agricultural productivity, high dependence on subsistence farming, and reliance on biomass energy, as well as governance challenges manifested in poor forest management due to inadequate budgets, weak local capacity, implementation bottlenecks, and policy gaps. An integrated approach involving stakeholders from different sectors is therefore important for implementing the recommended interventions.

Addressing the ongoing loss and conversion of natural forest is the overall goal of the proposed interventions, by tackling the destructive decline in forest cover and land degradation, adding value to trees in the landscape, creating the conditions to address the needs of refugees and the host community, and generating multiple benefits by bridging humanitarian responses and sustainable development.

The following intervention options can support sustainable environmental management, ensure energy access for cooking, and contribute to building livelihood resilience in both refugee and host communities. These can be also related to the Strategic Options elaborated in the National REDD+ Strategy and Action Plan:

- Development of agroforestry systems (ref: REDD+ Strategic Option 1);
- Establishment of private woodlots for energy and other purposes (ref: REDD+ Strategic Option 2);
- Restoration and conservation of natural forests in protected areas (ref: REDD+ Strategic Option 4);
- Rehabilitation and conservation of natural forests on private and communal land (ref: REDD+ Strategic Option 4); and
- Upgrading of cooking systems and energy value chains (ref REDD+ Strategic Option 5).

Each option is described in the following sections in more detail. Potential areas suitable for each intervention were mapped by combining different layers of information (protected areas, tree cover loss, LULC in 2017, distance to roads, and slope). The results of this land suitability analysis are presented for each AoI in Annex 2.

5.1 Development of agroforestry systems

Limited access to productive assets and agricultural land, and shocks from drought, water shortages, crop pests, and diseases, are factors that undermine refugee and host community households' resilience capacity (FAO 2019). It is noteworthy that competition in this case is not only between host and refugee populations, but also on land use and production systems across communities, gender, and age groups in search of opportunities for production, engagement in the various value chains (mainly agricultural), and employment. Best practices in Uganda such as agroforestry systems can be rolled out in refugee contexts generating multiple benefits and providing woodfuel, food, timber, fodder for livestock, and other non-wood forest products (NWFPs) because of their potential to complement - rather than compete with - agriculture in a situation of constrained space.

---

[30] Degradation is a process leading to a 'temporary or permanent deterioration in the density or structure of vegetation cover or its species composition' (FAO 2007).

[31] Deforestation is the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10 percent threshold (FAO 2017).

The objective of the intervention is to increase food and nutrition security as well as soil and water conservation through access to productive natural assets and skills enhancement in agroforestry production systems, in which suitable nutritious crops, as well as trees, will be intercropped.

Agroforestry is designed to address land degradation while also providing woodfuel, food (for example, edible leaves, fruits, and nuts), timber, fodder for livestock, and other NWFPs. The integration of trees into production systems can enhance livelihood opportunities and increase the resilience of both host and refugee communities, contributing to food and nutrition security and generating income. In addition, agroforestry represents a suitable activity for the restoration of degraded lands, bringing people involved to identify and implement specific practices in which woody perennials (bamboos, palms, shrubs, and trees) are combined with agricultural crops and/or animals on the same land management unit. Trees planted in agroforestry systems can ensure that the immediate food needs are met, while also providing shade, defining boundaries, and supporting ecosystem services such as soil conservation, soil fertility, and pollination services.

This intervention targets two levels based on land availability and tenure:

- At a household level, mainly as live fences and intercropping systems close to the residence;
- At a farm level, on cropped areas.

As part of this intervention, it is important to introduce training to raise awareness on the benefits of agroforestry, provide technical support and extension services, and encourage both host and refugee communities to adopt agroforestry systems. The involvement of the District Forest and Agriculture Offices could start with the support of relevant partners for the establishment of demonstration plots, tree nurseries, and training centers in the refugee settlements and surrounding villages.

Multipurpose and fast-growing woody species (for example, moringa, pigeon pea, and sesbania,) should be considered to increase the motivation of people to manage trees effectively, by providing several benefits that meet people’s needs, such as materials for fencing, fruits, fodder, and fuel, as well as ecosystem services, such as soil conservation and soil fertility.

Table 22 summarizes the estimated costs for agroforestry on a per-hectare basis. In this scenario, labor for land preparation, harvesting, and other field operations is deemed to be provided free of charge by the households.

Table 22. Indicative costs of agroforestry intervention, per-hectare basis

	Unit cost (US$/ha)	Year 1	Year 2	Total cost US$/ha)
Community tree/garden center (one per 30 ha of agroforestry)				
Establishment	312.0	1		312
Management	26.5	1	1	53
Agricultural inputs				
Seeds	20.0	1	1	40
Fertilizers	60.0	1	1	120
Training package				
Agroforestry experts and communication	20.0	1	1	40
Total				**565**

5.2 Establishment of private woodlots for energy and other purposes

Woodfuels are the main source of energy for cooking for both refugee and host communities in Uganda. Demand is expected to increase with rising population, as other energy options for cooking are often unaffordable or deliver inferior performance. As forest resources are depleted, especially for agricultural expansion, the imbalance between demand and sustainable supply will increase. This will place growing strains on the well-being of both hosts and refugees and may contribute to environmental impacts in refugee-hosting areas.

The objective of this intervention is to maximize biomass production in a short time and increase tree density to reach the optimum growth per unit of area. Fast-growing tree species and short-rotation coppice management should be adopted to enable early harvesting for firewood. The use of multipurpose species can increase people's motivation to manage trees effectively because of the provision of other benefits such as building poles and fence posts. It is important to highlight that labor needed for planting and tending for trees is particularly intense for at least the initial three years before they produce an appreciable quantity of biomass.

It is important that landowners are fully responsible for tree planting and management on their own land and for other aspects of this intervention, including dialogue and decision making, as project partners with their own cash and in-kind commitments. Technical staff of district local governments should provide on-site support for the selection of suitable species and development of a management plan with clear objectives and responsibilities.

Performance-based incentives, whether in the form of money or material inputs, should pass through an investment phase that should support both a successful establishment and the management after Year 1 for ensuring that the planted trees are maintained and protected. The existing Sawlog Production Grant Scheme (SPGS) is a long-term strategic intervention designed to enhance the supply of timber and can be tailored for productive forestry systems at a smaller scale. This scheme would also require significant support at a district level to manage and monitor large numbers of small landowners. Partnerships with local NGOs involved in small and medium enterprises can provide training to the beneficiaries in starting up and managing woodlots.

The land identified for potential woodlot establishment does not include protected areas, although the protected areas managed by the NFA might also be considered for this purpose. The potential land suitable for woodlots was identified for each target refugee settlement, as well as the 15 km buffer zone (Annex 2), while the technical specifications are provided in the methodology section (Annex 1).

A total of about 62,000 ha and 59,093 ha of lands are identified for potential woodlot establishment, within and beyond 500 m from main roads, respectively (Table 23). This 500 m distance, defined in an arbitrary way, is used for a first consideration of accessibility to the potential areas for woodlots. Most of these potential lands are located around the Nakivale-Oruchinga settlements.

Table 23. Potential areas suitable for establishment of woodlots within 15 km buffer zone

AoI	**Area (ha)**		**Total**
	<500 m from road	**>500 m from road**	
Kiryandongo	6,360	6,512	12,872
Kyaka II	6,228	17,261	23,489
Kyangwali	6,795	1,034	7,829
Nakivale-Oruchinga	26,847	33,223	60,070
Rwamwanja	15,769	1,063	16,832
Total	**62,000**	**59,093**	**121,093**

Part of the same land identified potentially suitable for woodlots (that is, degraded woodland) is also considered suitable for potential rehabilitation. A total of 1,638 and 1,601 ha of land are identified for potential woodlot establishment, respectively within/beyond 500 m from main roads (Table 24). Most of the suitable land parcels are in the Kiryandongo 15 km buffer zone.

Table 24. Potential areas suitable for establishment of woodlots or rehabilitation of degraded woodlands within 15 km buffer zone

AoI	Area (ha)		Total
	<500 m from road	>500 m from road	
Kiryandongo	1,415	1,180	2,595
Kyaka II	19	315	334
Kyangwali	53	36	89
Nakivale-Oruchinga	32	61	93
Rwamwanja	118	9	127
Total	**1,638**	**1,601**	**3,239**

Table 25 provides indicative costs of investment and operations for the energy woodlot working cycle. Establishment costs can vary significantly from district to district and are dependent on land type, vegetation, and other site-specific biophysical and socioeconomic factors.

Table 25. Woodfuel plantation establishment and maintenance costs

Operation	**Unit cost (US$/ha)**	**Year**						**Total US$/ha)**
		0	**1**	**2**	**3**	**4**	**5**	
Surveying and planning	25	1						25
Land clearing	90	1						90
Land preparation (slash and burn)	33		1					33
Preplant weed spraying	43		1					43
Marking and pitting	43		1					43
Preplant termite control	133		1					133
Planting (including seedlings)	260		1					260
Blanking	52		1					52
Post-plant termite control	133		1					133
Post-plant manual weeding (ring hoeing)	23		1	1				92
Post-plant manual weeding (slashing)	30		1	1				60
Post-plant chemical weeding	42		1	1	1			336
Fire protection	50		1	1	1	1	1	250
Harvesting (coppicing and pollarding)	110						1	110
Technical management	3		1	1	1	1	1	15
Administration	2		1	1	1	1	1	10
							Total	**1,685**

Under this intervention, productive woodlots in Uganda can achieve mean annual increments of 20–26 m^3 per hectare. Assuming average wood density of 600 kg/m^3 and a biomass expansion factor of 1.5 (to include bark and branches), the total AGB increment achievable with tree plantations would be 18.0–23.4 t per hectare per year (dry weight). To compensate fully for the estimated annual loss of biomass (Table 21) and ensure a fuel security for cooking using the local resources, the minimum area of woodlots needed to meet the total woodfuel demand of the current refugee population in each settlement has been calculated in Table 26.

Table 26. Woodlot requirements for energy

AoI	AGB loss (t/yr)	Woodlot area (ha)	Minimum woodlot area per household (ha)
Kiryandongo	63,877	2,730	0.14
Kyaka II	89,942	3,844	0.14
Kyangwali	81,861	3,498	0.10
Rwamwanja	45,410	1,941	0.10
Total	**281,090**	**12,013**	**-**

Note: AGB loss refers to the gap between annual woodfuel demand and biomass growth in the settlement area plus 5 km buffer zone.

5.3 Restoration and conservation of natural forests in protected areas

5.3.1 Description

These interventions would target the restoration of degraded forest and the conservation of intact forest within protected areas. These include wildlife conservation areas managed by the UWA and CFRs managed by the NFA.

The recommended interventions cover five CFRs, two WRs, and one NP (Table 27). Potentially suitable land was mapped for each target refugee settlement and the 15 km buffer zone (Annex 2), while the technical specifications are provided in the methodology section (Annex 1).

Restoration aims to reinstate the capacity of degraded forest to its original state, that is, to reestablish the presumed structure, productivity, and species diversity of the forest originally present at a site before the forest loss. The restoration of degraded natural forests in protected areas through assisted natural regeneration will include protection measures aimed at shielding remnant trees from logging, firewood harvesting, livestock grazing, fire, and other destructive agents. A total of 1,083 ha of land is identified for restoration in protected areas where tree cover loss has recently occurred (that is, between 2014 and 2018). Most of these lands are in Kiryandongo (about 703 ha) and Kyangwali (about 187 ha), as shown in Table 27.

Table 27. Potential areas for restoration of natural forests in protected areas

AoI	Protected area	Area (ha)
Kiryandongo	Karuma WR	52
	Kibeka CFR	169
	Nyamakere CFR	481
	Kiryandongo total	**703**
Kyaka II	Buhungiro CFR	13
	Rwensambya CFR	90
	Kyaka II total	**102**
Kyangwali	Bugoma CFR	**187**
Nakivale-Oruchinga	Lake Mburo NP	**72**
Rwamwanja	Katonga WR	**19**
	Total	**1,083**

In addition, within the 15 km buffer zone around the refugee settlements, almost 38,000 ha of intact natural forests in protected areas have been identified for conservation support to preserve forest cover that still exists (Table 28). The highest occurrence is found in the buffer zone of Kiryandongo (about 12,449 ha), followed by Kyangwali (9,019 ha) and Rwamwanja (8,888 ha). Among the protected areas, the highest occurrence of intact natural forests is found in Karuma WR (10,284 ha).

Table 28. Conservation of intact natural forests in protected areas within 15 km buffer

AoI	Protected area	Area (ha)
Kiryandongo	Karuma WR	10,284
	Kibeka CFR	1,389
	Nyamakere CFR	776
	Kiryandongo total	**12,449**
Kyaka II	Buhungiro CFR	293
	Rwensambya CFR	292
	Kyaka II total	**592**
Kyangwali	Bugoma CFR	**9,019**
Nakivale-Oruchinga	Lake Mburo NP	**7,052**
Rwamwanja	Katonga WR	**8,888**
	Total	**37,993**

The main strategies for the proposed restoration and protection intervention include (a) locating and releasing natural regeneration, (b) enrichment planting using indigenous species, and (c) protective measures. Field operations under the conservation of intact natural forests in protected areas will mainly focus on protection activities such as surveying, monitoring, awareness creation, and fire protection.

A Forest Management Plan (FMP) should always be developed for the natural forest lands within each protected area, to meet specific local conditions and needs. Such plans should take into account government priorities and the specific needs of host communities and refugees. It is important to highlight that in situations of new displacements or new refugee influx, a preventive approach should be adopted to minimize environmental risks.

5.3.2 Indicative costs

Table 29 provides indicative costs for the conservation of natural forests in protected areas. Field operations under the conservation of natural forests in protected areas should focus on surveying, monitoring, boundary maintenance, fire protection, and awareness creation about the need to manage existing natural resources. Costs of restoration can vary significantly depending on land type, vegetation, and other site-specific biophysical and socioeconomic factors. Further investigations are required to analyze site-specific conditions.

Table 29. Indicative costs for conservation of natural forests in protected areas, per-hectare basis over five years

Operation	Unit cost (US$/ha)	Year						Total cost (US$/ha)
		0	1	2	3	4	5	
Surveying and preparation of an FMP	25	1						25
Boundary maintenance	15		1				1	30
Fire protection	50		1	1	1	1	1	250
Watching	1		1	1	1	1	1	5
Awareness creation	2		1	1				2
Technical management	3		1	1	1	1	1	15
Administration	2		1	1	1	1	1	10
							Total	**337**

The proposed restoration intervention in degraded natural forests in protected areas also includes enrichment planting with additional indigenous tree species, alongside protective measures in the form of boundary maintenance, fire protection, and weed control. Table 30 provides indicative costs for restoration through assisted natural regeneration and protection.

Table 30. Indicative costs for assisted natural regeneration and protection of natural forests in protected areas, per-hectare basis over five years

Operation	Unit cost (US$/ha)	Year						Total cost (US$/ha)
		0	1	2	3	4	5	
Surveying and preparation of an FMP	25	1						25
Spot land preparation (slashing)	11		1					11
Spot preplant weeding	14		1					14
Spot pitting	14		1					14
Planting (including seedlings)	104		104					104
Blanking	25			1				25
Post-plant spot weeding and ring hoeing	12		1	1				24
Boundary maintenance	15		1				1	30
Fire protection	50		1	1	1	1	1	250
Watching	1		1	1	1	1	1	5
Awareness creation	2		1	1				4
Technical management	3		1	1	1	1	1	15
Administration	2		1	1	1	1	1	10
							Total	**531**

5.3.3 Key activities for restoration and conservation interventions

5.3.3.1 Preparation and development of restoration/conservation management plans

Activity 1.1: Field visit to identified restoration and protection sites to confirm current land use and degradation or deforestation status, nature of vegetation and tree cover, risk of waterlogging, and any soil erosion.

Activity 1.2: Analyze and evaluate the specific drivers of deforestation or forest degradation in the identified areas suitable for restoration.

Activity 1.3: Engage all stakeholders that can contribute to the management of the protected areas, including local communities and refugee representatives, to discuss long-term goals of forest restoration and conservation measures considering the interests and needs of all groups, and draft a preliminary restoration/conservation plan. Stakeholder engagement should take into account gender issues.

Activity 1.4: Develop a restoration/conservation management plan, including

- Designating forest functions and assessing accessibility to the sites (considering roads and natural or artificial barriers), existence of natural regeneration, and needs for enrichment planting;
- Agreeing on restoration/conservation objectives with all stakeholders;
- Selecting the restoration/rehabilitation modality;
- Choosing the right indigenous species to be used and identifying existing nurseries near the interventions;
- Calculating the number of seedlings needed for the sites and determining the work required for the restoration and conservation of natural forests in each protected area and the availability of local labor for each phase of implementation;
- Determining the need for fencing part of the protected area that in some cases, despite the cost, may be essential for success of restoration or conservation measures in areas with high natural value;
- Conducting a cost-benefit analysis of restoration targeting all major sites; and

- Assessing potential sources of conflict and tension between the displaced and host communities and possible opportunities to support the development of local economies through sustainable NWFP value chains.

5.3.3.2 Capacity building and management

Activity 2.1: Assess local capacity-building needs and plan for the necessary training. Ongoing capacity development through professional education and training, extension support services, and the strengthening of national research capabilities is essential for improving planning, management, and technical decision making on forest restoration and rehabilitation and to enable organizations to understand and respond to the priority needs and aspirations of stakeholders.

Activity 2.2: Establish realistic time schedules and conduct a cost-benefit analysis of restoration targeting all major sites. Forest restoration and rehabilitation are long-term investments preparing the way for sustainable forest and land management. They require awareness and diligence in policy and planning to mitigate the ecological and socioeconomic risks associated with them.

Activity 4.3: Ensure that all stakeholders, including refugees and local community representatives, are aware of, and understand, the decisions taken in the restoration/conservation management plans.

5.3.3.3 Site preparation and planting for restoration sites

Activity 3.1: Seed collection and seedling production. Where the aim is to restore or reestablish a natural forest, efforts should be made to collect seeds and other propagative material from a diverse range of native plants in the local area. Ensure that the period of the early rainy season coincides with the readiness of seedlings. After hardening off, move them to new beds two weeks before out-planting. This ensures that only seedlings that survive this move (which may cause uprooting if the seedlings have grown roots outside their container) are out-planted.

Activity 3.2: Spatial organization and site preparation. Perform preliminary weeding in locations covered by grasses and shrubs. The pit marking operation is then conducted before planting following the instructions given in the management plan. The total carrying capacity range for restoration interventions is usually 400–1,000 stems per hectare. Dig pits and weed around pits.

5.3.3.4 Protection/conservation

Activity 4.1: Monitor restored/conserved areas and conduct maintenance activities as required. Tree seedlings - whether planted or established naturally - may need to be protected for up to five years after establishment against competition from weeds for light, moisture, and nutrients; wildfire; and browsing by wild and domestic animals. A ground survey should be conducted three to six months after the planting event to assess the establishment rate. Dead seedlings should be replaced early in the next rainy season, ideally with seedlings of a similar size to those surviving nearby.

5.4 Rehabilitation and conservation of natural forests on private and communal land

5.4.1 Description

The purpose of forest rehabilitation is to restore the capacity of degraded forest land to deliver forest products and services. Forest rehabilitation reestablishes the original productivity of the forest and some, but not necessarily all, of the plant and animal species thought to be originally present at the site.

Land proposed for rehabilitation and conservation of natural forests targets THF and woodlands owned by host communities and individuals. Given that this intervention package will use the governance framework of community forests, it will include the development of new Community Forestry Regulations under the National Forestry and Tree Planting Act to clarify collective rights and responsibilities. Potential beneficiaries of this intervention can be private landholdings as well as institutions in possession of a clear title: churches, mosques, schools, health facilities, and other centers.

The rehabilitation of degraded natural forests can be a relatively cost-effective means of sustainably managing native resources to rehabilitate land productivity through natural or assisted regeneration using indigenous tree species, in which the harvesting of forest products will be controlled and regulated under site-specific management plans. Efforts to rehabilitate forests will aim to address land stabilization, biodiversity conservation, and soil and water protection, including the additional benefit of expanding on the NWFPs available. Harvesting of commercial NWFPs within sustainable limits will be permissible, to ensure a financial incentive for forest owners to manage their joint resource judiciously.

A key element for a successful rehabilitation and conservation of natural forests on communal land is that the right to access the land and to harvest wood and NWFPs should be understood and agreed with all the members of the communities next to the forests (including with the refugees). The lack of collective rights and benefits could encourage unsustainable harvesting of forest products for short-term economic rewards rather than to incentivize long-term sustainable utilization.

Sustainable use of forest resources can contribute significantly to community resilience by ensuring long-term access to income, food, and other household resources from remaining forest blocks. It is therefore important that people are engaged in the rehabilitation of degraded forests through a participatory approach, to ensure the wise use of natural resources and ensure ongoing sustainable benefits.

The assisted natural regeneration of degraded forests should be carefully planned, as the nature and extent of recovery depend on the ecology and disturbance of the areas and the condition of the landscape. A detailed land use assessment is required for each settlement, to define detailed measures for assisted natural regeneration of forest productivity.

Potential areas suitable for rehabilitation and conservation of natural forests on communal or private land were mapped for each target refugee settlement and the 15 km buffer zone (Annex 2), while the technical specifications are provided in the methodology section (Annex 1).

Of the 1,126 ha of land identified for rehabilitation of degraded natural forests on private and communal land where recent tree cover loss was observed (from 2013 to 2018), 645 ha and 417 ha are in Kyaka II and Kyangwali, respectively, and 64 ha in Rwamwanja (Table 31).

Table 31. Potential areas for rehabilitation of degraded natural forests on private and communal land within 15 km buffer

AoI	**Area (ha)**
Kyaka II	645
Kyangwali	417
Rwamwanja	64
Total	***1,126***

In addition to restoration activities, measures to conserve the remaining pockets of intact natural forests in community and private land are recommended to conserve biological diversity, ecosystems, and natural resources, especially soil and water, as well as to ensure that the aesthetic, cultural, and spiritual values of natural forests are retained.

As shown in Table 32, nearly 21,000 ha of intact natural forests are identified on private and communal land for conservation activities. Most of these areas are located around Kiryandongo (8,990 ha) and Kyaka II (5,682 ha).

Table 32. Potential areas for conservation of intact natural forests on private and communal land within 15 km buffer

AoI	**Area (ha)**
Kiryandongo	8,990
Kyaka II	5,682
Kyangwali	2,416
Nakivale-Oruchinga	1,633
Rwamwanja	2,236
Total	***20,957***

5.4.2 Indicative costs

The indicative costs for rehabilitation of degraded natural forests on communal and private land (Table 33) are similar to those provided for restoration in protected areas. The key operations include enrichment planting with indigenous tree species and protective measures in the form of fire protection and weed control. Costs of rehabilitation can vary significantly from district to district and are dependent on land type, vegetation, and other site-specific biophysical and socioeconomic factors. Further investigations are required to analyze site-specific conditions.

Table 33. Indicative costs for rehabilitation and protection of natural forests in communal and private land, per-hectare basis over five years

Operation	**Unit cost (US$/ha)**	**Year**						**Total cost (US$/ha)**
		0	**1**	**2**	**3**	**4**	**5**	
Surveying and preparation of an FMP	25	1						25
Spot land preparation (slashing)	11		1					11
Spot preplant weeding	14		1					14
Spot pitting	14		1					14
Planting (including seedlings)	104		104					104
Blanking	25			1				25
Postplant spot weeding and ring hoeing	12		1	1				24
Boundary maintenance	15		1				1	30
Fire protection	50		1	1	1	1	1	250
Watching	1		1	1	1	1	1	5
Awareness creation	2		1	1				4
Technical management	3		1	1	1	1	1	15
Administration	2		1	1	1	1	1	10
							Total (US$/ha)	**531**

5.4.3 Possible incentives mechanisms for conservation

The following incentive schemes can be explored to enhance the conservation of intact natural forests within both the refugee settlements and host community lands:

a) Partnerships with local NGOs involved in small and medium enterprises, to train communities in starting up and managing short-term projects, such as developing beekeeping value chains, within the area for protection for short-term returns.

b) Training in sustainable harvesting techniques of NWFP and methods to replace, expand, or extend indigenous species.

c) Payment for ecosystem services to motivate the host community to rehabilitate and protect the resulting native forests from threats.

d) Clarification on tenure rights and enforcement of regulations to motivate individuals and communities to invest time in sustainable forest resources management.

5.5 Upgrading of cooking systems and energy value chains

In line with Uganda's Vision 2040 (NEMA 2016), this intervention explores the enhancement of energy efficiency through scaling up training of communities in woodfuel saving practices, adopting more efficient cookstoves, improving charcoal production technologies, and exploring alternative energy sources for cooking.

The assessment reveals a significant proportion of households that are still using the three-stone fire, particularly in the host communities (76.2 percent), though less so in the surveyed refugee settlements (33.5 percent) where (for example, in Kyaka II) charcoal stoves have been provided or purchased. Nonetheless, there is a generally poor adoption rate of fuel-saving cookstoves and energy efficiency practices. Both government agencies and NGOs have promoted stoves to reduce woodfuel demand, but with limited success, mainly due to lack of financial mechanism to make them more affordable. This study has also noted that fuel economy is not necessarily a high priority on the part of users.

The promotion of cleaner, quicker or more efficient cooking systems, along with user education, should take into account an integrated and coordinated approach to be based on the needs and the cultural habits of the final users. A variety of stoves are available in the national market although affordability, quality standards, and local distribution represent challenges.

A dual-fuel stove designed to function with both firewood and charcoal might be a step-change from mud stoves, but it would still be culturally appropriate and affordable. New production centers could be set up at one or two locations in western Uganda to supply the settlements, under a cost-sharing arrangement with refugees and locals. Existing providers could be encouraged to extend their outreach to the refugee-hosting areas through partnerships with a refugee-affected area program.

Charcoal production is also undertaken as a business by both host and refugee communities. This was observed in the areas surveyed, particularly in Kyangwali, in the areas bordering Bugoma CFR, and in Kyaka II, where the effective 'urbanization' of the areas has increased the demand for charcoal for commercial uses as well. Charcoal production techniques were observed to be traditional and relatively inefficient.

Promoting modern, improved kilns, as well as improving the management of traditional ones, such as the improved basic earth kiln (IBEK), through training, exchange, and dialogue between charcoal producers, is recommended to enhance conversion efficiency. A training package at the household level is also recommended in this intervention to raise awareness and enhance energy-saving practices for cooking (Table 34). Reducing demand for woodfuel at the household level while providing access to alternative energy sources can shorten the time spent throughout the day, mainly by women and children, for firewood collection. This will contribute to household productivity potential and the livelihood resilience of both refugees and hosts.

Table 34. Indicative costs for cooking energy enhancements

		Year 1	Year 2	Total cost (US$)
Household training package and equipment	**US$ per HH**			
Demonstrations for energy-saving measures at the household level	5	1	1	10
Equipment and materials	15	1		15
			Total per HH	**25**
Improved charcoal production	**US$ per unit**			
Improved kiln (portable or IBEK)	2,200	1		2,200
Start-up cost	500	1		500
Kiln demonstration and training	1,000	1	1	2,000
			Total per charcoal unit	**4,700**

Note: HH = household.

Fact sheet: Alternative energy sources for cooking

Although the respondents of the household survey reported the use of only firewood, charcoal, and agricultural residues, the National Household Survey for Uganda (UBOS 2017) reveals that 6 percent of Ugandan households in rural areas, and 11 percent in urban areas, use other sources of energy for cooking (electricity, kerosene, liquified petroleum gas [LPG], etc.). Specifically, for the southwest districts of Uganda, the usage of alternatives is at only 4.5 percent. There have been efforts to promote briquette production from charcoal dust and agricultural residues supported by Action Africa Help and the Lutheran World Federation, for instance, in Kyangwali and Kagwaya Subcounties, and by Adapt+ in Kyaka II settlement.

A cost comparison between various energy sources for cooking is provided in Table 34. The figures assume the average energy content (in MJ/kg) of the fuel options being considered and the average efficiency rating of the most commonly used stoves. These factors have been considered in the computation of final energy delivered for cooking and heating water and hence to calculate the unit cost.

Table 35. Average cooking fuel cost comparison

Fuel	**Firewood**	**Charcoal**	**Charcoal briquettes**	**LPG**
Energy content (MJ/kg)	13.8	30.8	18.8	46.3
Stove efficiency	17.3%	31%	31%	48%
Retail price (UGX/kg)	141	667	850	9,231
Cost of energy (UGX/MJ)	10.2	21.6	45.2	199
Cost of delivered energy (UGX/MJ)	**59.0**	**69.8**	**146**	**415**
Cost of delivered energy (USD/MJ)	**0.016**	**0.019**	**0.039**	**0.110**

Exchange rate: UGX 3 770 per USD. Note: fuel prices are at refugee settlement level in western Uganda.

Table 35 also illustrates how firewood and charcoal remain the cheapest and most accessible fuel, and it would be very difficult for low-income households to adopt the alternative energy options considered. Switching to clean fuels would require a large change in household expenditure patterns and increased incomes. Transitioning from traditional cooking practices to the use of modern fuels may take considerable time, even with adequate resources. Therefore, in the short and medium term, while encouraging a transition to access to affordable, reliable, sustainable and modern energy, it is important to sustainably produce firewood and charcoal and to use them through more efficient practices and cookstoves.

6 CONCLUSIONS

The population of western and southwestern Uganda has increased following the settlement of close to 500,000 refugees, many of them fleeing the deteriorating security situation in the Democratic Republic of the Congo in 2018. There is a resultant risk of added pressure on forest resources, which can exacerbate ongoing environmental degradation and affect the well-being and livelihoods of refugees and host communities alike.

The study has shown that host and refugee communities rely upon woodfuel to meet their energy needs. Firewood is dominant at Kyangwali settlement, where it is the primary fuel for 75.5 percent of households, while charcoal dominates at Kyaka II (where it is the main fuel for 77.5 percent of households). A similar but less pronounced pattern is seen among host community households, with firewood dominant in the villages around Kyangwali (92.5 percent of households) and less so around Kyaka II (78.7 of households).

Refugee households where firewood is the primary fuel use less firewood on average than host community households where firewood is the main fuel. This is the case with both surveyed settlements. Similarly, refugee households using charcoal as their main fuel use less charcoal on average than host community households where charcoal is the main fuel, also in both locations. As a greater proportion of refugee households use charcoal as their main fuel, however, total average woodfuel consumption is higher for refugees than hosts in terms of 'firewood-equivalent'. In the two settlements that were sampled, average daily woodfuel consumption in firewood-equivalent totals 2.6 kg pppd at Kyaka II and 2.8 kg pppd at Kyangwali, compared with 2.3 kg pppd and 2.6 kg pppd, respectively, for host community households around the same settlements.

There has been little adoption of clean, modern, and efficient cooking systems. The use of traditional hearths could expose the population to health risks from smoke inhalation. Few improved charcoal stoves were observed, and several locally designed mud stoves have been adopted across homes in some refugee and host communities. There is a desire to optimize fuel consumption through more efficient and modern cookstoves. In spite of this, several household respondents have not heard of improved cookstoves and others are less committed to adopt them due to cooking habits and practical issues (for example the need to cut the firewood into smaller pieces).

Forests and other woodlands around the refugee settlements and across Uganda have been in decline. The study has shown that between 2001 and 2018, total tree cover loss in the AoI of Kyaka II and Kyangwali was nearly 10 percent or higher in both the 5 km and 15 km buffer zones from the settlement boundaries. It is noteworthy, however, that the temporal pattern of tree cover loss around these settlements does not seem related to refugee population changes. In Kiryandongo and Kyaka II, while periods of higher tree cover loss do seem broadly related to the arrival of refugees, a spike in tree cover loss one year ahead of the most recent refugee influx may suggest that recent losses could also be a result of clearing of land in preparation for their imminent arrival. In Kiryandongo, 73 percent of the recorded tree cover loss from 2001 to 2018 occurred in natural forests, while in Kyaka II the proportion is 55 percent. Over 2001–2018, the tree cover loss in Kyangwali was the highest among the other AoIs, with 37 percent of the total loss occurring in natural forests. Although in this case, any link between tree cover loss and the refugee influx is less evident. The tree cover loss phenomenon is less prominent in the Nakivale-Oruchinga settlements, with 6 percent of total tree cover loss occurring in natural forests, whereas 49 percent takes place in natural forests in Rwamwanja settlement, up to the 15 km buffer.

The results of the analysis of tree cover loss and LULC changes do not always reflect the losses of AGB that would be expected based on the demand for woodfuel from refugee and host communities living up to 5 km from the settlement boundaries. In other words, the projected imbalance between woodfuel demands AGB stocks is often not reflected in the remote sensing analysis and recorded losses of AGB. This can perhaps be explained by partial supply of woodfuel (especially charcoal) from other areas and possibly by absenteeism among both locals and refugees. Overall, the LULC transition classes also indicate that tree cover loss is driven by multiple factors, such as agricultural expansion, woodfuel harvesting, and expansion of settlement areas.

The study proposes a range of interventions to mitigate forest degradation and enhance energy access for both refugee and host communities, while also improving the livelihood and income sources of both communities. Due to the current high dependency of both refugees and hosts on charcoal and firewood, and given the likelihood that this dependency is expected to continue for the foreseeable future, responsible planning for sustainable management of wood resources offers opportunities to sustainably supply woodfuel, create employment and income through forest product value chains, and contribute to a wide range of ecosystem services. The interventions proposed include (a) development of agroforestry systems, (b) establishment of private woodlots for energy and other purposes, (c) restoration and conservation of natural forests in protected areas, (d) rehabilitation and conservation of natural forests on private and communal land, and (e) upgrading of cooking systems and energy value chains.

Institutional and capacity-building measures to support the proposed interventions include (a) formation and governance strengthening, (b) natural resource management skills, and (c) strengthening of the institutional capacity of central and local authorities for forest management.

7 BIBLIOGRAPHY

Action Africa Help. 2016. *Understanding the Dynamics for Utilization of Household Cooking Energy in Kyangwali refugee settlement*.

———. 2017. 2017 *Annual Report Uganda Program.* 1–22.

Akello, C. E. 2007. *Environmental Regulation in Uganda: Successes and Challenges.*

De la Rue du Can, S., D. Pudleiner, D. Jones, and A. Khan. 2017. *Energy Efficiency Roadmap for Uganda: Making Energy Efficiency Count.*

Dubovyk, O. 2017. *The Role of Remote Sensing in Land Degradation Assessments: Opportunities and Challenges.* European Journal of Remote Sensing 50(1): 601–613. doi:10.1080/22797254.2017.1378926

DRC (Danish Refugee Council). 2018. *Rapid Conflict Assessment in Kyaka II Refugee Settlement, Uganda.*

EPRC (Economic Policy Research Centre). 2015. *Natural Resource Management in the Albertine Graben Region of Uganda: Baseline Survey Report.* Research Reports 206172, EPRC. doi: 10.22004/ag.econ.206172

Forest Department. 2002. *National Biomass Study. Technical Report.* Kampala, Ministry of Water Lands and Environment.

FAO (Food and Agriculture Organization of the United Nations). 2007. *Manual on Deforestation, Degradation, and Fragmentation Using Remote Sensing and GIS.*

———. 2015. *State of Uganda's Forestry 2016.*

———. 2019. *Resilience Analysis in Southwest Uganda.* Rome

FAO and OPM. 2018. *Food security, resilience and well-being analysis of refugees and host communities in Northern Uganda*. Rome. 78 pp.

FAO and UNHCR. 2018. *Managing forests in displacement settings: guidance on the use of planted and natural forests to supply forest products and build resilience in displaced and host communities*.

Funk, C., P. Peterson, M. Landsfeld, D. Pedreros, J. Verdin, S. Shukla, and J. Michaelsen. 2015. *The Climate Hazards Infrared Rainfall with Stations—a New Environmental Record for Monitoring Extremes.* Scientific Data 2, 150066. doi:10.1038/sdata.2015.66

GoU (Government of Uganda). 2015. *SREP Investment Plan for Uganda*. https://www.climateinvestmentfunds.org/sites/cif_enc/files/srep_14_8_srep_investment_plan_for_uganda_final_version_0.pdf

———. 2018. *Roadmap for the Implementation of the Comprehensive Refugee Response Framework in Uganda 2018–2020.*

———. 2018. *CRRF Communication and Outreach Strategy 2018/20.* November 2018.

M. C. Hansen, P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D.Thau, S.V.Stehman, S.J.Goetz, T.R.Loveland, A.Kommareddy, A.Egorov, L.Chini, C. O. Justice, J. R. G. Townshend. 2013. *High-Resolution Global Maps of 21st-Century Forest Cover Change.* Sci., 342(6160), 850-853. doi:10.1126/science.1244693

Internews. 2018. *Rapid Assessment on Information Ecosystem and Access to Justice for SGBV Survivors Kyangwali Refugee Settlement, Uganda.* December 2018.

Kreibaum, M. 2014. *Their Suffering, Our Burden? How Congolese Refugees Affect the Ugandan Population.*

Lutheran World Federation. 2018. *Lutheran World Federation Uganda Annual Report 2018.*

MWE (Ministry of Water and Environment). 2013. *The National Forest Plan 2011/12–2021/22.* Kampala: MWE.

———. 2015. *Guidelines for the Registration, Declaration and Management of Community Forests*.

———. 2016. *Forest Landscape Restoration Opportunity Assessment for Uganda*. Nairobi: IUCN.

———. 2018. *Proposed Forest Reference Emission Level for Uganda.* Kampala: MWE.

MWE and WB (World Bank). 2017. Forest Investment Program for Uganda. Kampala: MWE

NEMA (National Environment Management Authority). 2016. *State of the Environment Report for Uganda 2014.* Kampala: NEMA.

OAG (Office of the Auditor General Uganda). 2010. *Environmental Audit Report on Forestry Activities in Uganda.* Kampala: OAG

OPM (Office of the Prime Minister)-UNHCR. 2019. Uganda Country Refugee Response Plan. *The Integrated Response Plan for Refugees from South Sudan, Burundi and the Democratic Republic of the Congo.* UNHCR, Regional Refugee Coordination Office (RRC), Nairobi, Kenya.

Plumptre, A, S. Akwetaireho, D.C. Hänni, M. Leal, N. Mutungire, J. Kyamanywa, D. Tumuhamye, J. Ayebale, S. Isoke. 2010. *Biodiversity surveys of Bugoma forest reserve, smaller central forest reserves, and corridor forests south of Bugoma.* Uganda: the Jane Goodall Institute. https://doi.org/10.5167/uzh-57958

UBOS (Uganda Bureau of Statistics). 2015. *UBOS 2015–2030 Population Projections by Subcounty and Sex.*

———. 2016. *Uganda Towns.* Retrieved from http://www.energy-gis.ug/gis-data

———. 2017b. *Uganda National Household Survey 2016/17.* September 2017.

———. 2018a. *Uganda National Household Survey 2016/2017.* Kampala, Uganda: UBOS. https://www.ubos.org/wp-content/uploads/publications/03_20182016_UNHS_FINAL_REPORT.pdf

———. 2018b. *Uganda Districts Boundaries, July 2018.* Retrieved from http://ubos.geo-solutions.it/layers/geonode:uganda_districts_2018#more

UNHCR (United Nations High Commissioner for Refugees). 2017. *Translating New York Declaration Commitments into Action.* 1–3.

WFP (World Food Program). 2018. *Annual Country Report 2018.*

World Bank and FAO. 2018. *Rapid Assessment of Natural Resources Degradation in Areas Impacted by the South Sudan Refugee Influx in Northern Uganda (English).* Washington, DC: World Bank Group.

ANNEX 1: METHODOLOGIES

A. Socioeconomic survey

Desk review

Desk review provided information on the political and institutional setup for refugee management in Uganda, as well as the governance landscape of the national environment, energy, and natural resources sectors, specifically encompassing strategies for addressing the additional impacts resulting from hosting refugees. Desk review further revealed the stakeholders from the humanitarian sector engaged in energy and environment initiatives, and working for the efficient management and use of natural resources.

Research design

The socioeconomic survey was carried out in two of the six target refugee settlements plus a sample of nearby Ugandan communities. The survey was administered at a household level and explored the diverse elements of biomass use and demand/supply interactions, while also investigating family livelihoods to develop interventions for the promotion of resilience and sound natural resource management. The assessment also considered contextual circumstances pertaining to refugee protection and their integration into national development plans, such as the CRRF. It therefore involved identification and review of relevant institutional data and policy documents, together with reports of similar activities undertaken by others in this sector and region. The study tapped into the knowledge and contributions of different groups of people both inside and outside the AoIs, including those working in central government, local government, and the humanitarian sector, to consolidate the delivery of comprehensive results.

Sampling strategy

Two refugee settlements were purposefully selected, and the results extrapolated to gain an estimate of biomass use and related issues for all six target AoIs. Having considered the extent of tree cover loss, the presence of protected areas characterized by tropical high forest land cover in the AoI, and the populations of the settlements, Kyaka II and Kyangwali were selected for the socioeconomic surveys, field visits for ground truthing of degradation hot spots, understanding of the main drivers of changes, and identification of practical interventions. Both settlements were receiving new refugee arrivals at the time of the study.

The geographic divisions within the refugee settlements were obtained from the OPM Settlement Commandants. Sample villages and zones were selected based on numbers of households, arrival dates of settlers, degree of diversity, and accessibility. Further consultation with village and zonal leaders (represented through Refugee Welfare Committees inside the refugee settlements) built goodwill and support for the implementation of the survey.

Within the host communities, village and parish lists were obtained from subcounty headquarters and villages within 5 km and 15 km buffers were selected through random sampling, then fine-tuned through consultation with District Local Government staff, UNHCR, and the OPM to ensure a representative cross-section. Members of the village leadership structures were consulted before the study, with village chairmen serving as key informants. Six host villages were eventually chosen: Bujubuli West, Kyakakwanzi, and Nyakatooke in Kyegegwa District and Rwengabi, Hanga 2A, and Wairagaza in Kikuube District.

For the administration of interview questionnaires, households were selected semi-systematically. On reaching a village, the team located the residence of the village chairman and (s)he provided guidance on how to proceed with systematic sampling with his/her home set as the starting point. From there, every third household was selected for the densely populated villages and urban centers, while a 'skip-one' approach was employed for villages with wide distance between households. This approach was also used because data on total household numbers were unavailable in the majority of locations, which limited the application of a pure systematic sampling method. In total, 688 refugee and host community households were surveyed by four enumerators and one FAO supervisor. This sample has been designed taking into account a two-stage sample selection asking for an overall error of maximum 0.05 with a confidence level of 95%. The data collected on fuel consumption from 24 households (3.5 percent of the sample) were excluded during data cleaning and validation due to errors and inconsistencies.

Data collection and analysis

Before embarking on the field data collection exercise, the four enumerators were oriented on the topic of forestry and household biomass energy, use of tablets for data collection along with the software installed for the purpose of capturing household data, structure of the questionnaire, tools to be used in weighing of woodfuel and their calibration, and the explanation of technical terms. The data collection tool was pretested under the supervision of the FAO technical team, to iron out any bugs, ascertain understanding, and permit an estimation of time requirements to complete one survey. A survey timetable was then drafted, indicating the specific locations, key people to meet and their contacts, and the target number of surveys to be implemented each day.

Data were collected using Open Foris Collect Mobile software *v. 3.2.2*, an Android application for fast intuitive environmental monitoring using digital tablets. All data were exported into Excel spreadsheets.

Quantitative data on woodfuel consumption were obtained through in situ weighing of both charcoal and firewood, using 40 kg hanging scales, while qualitative data were obtained through questionnaire-led interviews and observation of socioeconomic aspects of the households, supported with photographs.

Assumptions

- Sampled villages and zones both in the refugee settlements and host communities are true representatives of the entire settlements and host communities.
- For the estimation of host community populations, the growth rate was constant over the period of projection.
- On the estimation of daily per capita woodfuel consumption, there are no significant seasonal variations affecting demand and the cooking time is always the same.
- The average moisture content of firewood was considered at 18 percent.
- Respondents had sincere interest in participating in the assessment and did not have any other motives such as receiving fuel, food, or stoves.

B. Tree cover, LULC, and Biomass stock changes

Data sets used

The following data sets were used in the analysis:

- Refugee settlement boundaries from https://data2.unhcr.org/
- Global Forest Change data set (Hansen et al. 2013) to compute statistics on tree cover loss from 2001 to 2018 from https://developers.google.com/earth-engine/datasets/catalog/UMD_hansen_global_forest_change_2018_v1_6
- National LULC maps for 2000 and 2017 provided by the NFA
- AGB stock data by LULC classes provided by the NFA
- Average annual biomass increments from the Forest Department NBS 2002
- Forest reserve and wildlife area boundaries provided by the NFA and UWA, respectively
- Refugee influx data from 2008 to 2018 collected from UNHCR
- Rainfall time series from Funk et al. (2015) obtained from https://developers.google.com/earth-engine/datasets/catalog/UCSB-CHG_CHIRPS_DAILY
- Harmonized World Soil Database data downloaded from http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/
- Shuttle Radar Topography Mission data at 30 m resolution downloaded from http://opendata.rcmrd.org/datasets/uganda-srtm-dem-30-meters
- District boundaries downloaded from UBOS (2018b)

Change detection

Change detection included assessment of changes in both tree cover and biomass. To assess tree cover change, zonal statistics of annual tree cover loss between 2001 and 2018 were computed for each AoI. This resulted in each AoI containing the number of pixels with tree cover loss for each year between 2001 and 2018. The annual tree cover loss percentage was calculated for each AoI as the number of pixels with tree cover loss divided by the total number of pixels. For biomass stock changes, biomass stock for each LULC class was assigned to the national LULC maps for 2000 and 2017. These two maps were then overlaid, and biomass stock changes were calculated by subtracting the pixel values in the biomass stock map of 2000 from that of 2017.

The legends of both the 2000 and 2017 maps contain 13 LULC classes. Three of these classes (THF, THFL, and Woodland) are considered as natural forest. The remaining classes are considered as 'other land'. Based on these broad classes, four transition classes from 2000 to 2017 (that is, other land - other land, other land - natural forest, natural forest - other land, and natural forest - natural forest) were used to categorize tree cover loss.

Processing for biomass estimates

AGB stocking for each land cover class was harmonized with the classes in the LULC map as shown in Table 36.

Table 36. Harmonization of classes of the LULC map and AGB stock data

Class in LULC map	Code	Class in biomass data	Average AGB (t/ha)
Plantations, broad-leaved	1	Plantation - deciduous	90.6
Plantations, coniferous	2	Plantation - coniferous	53.9
THF	3	Tropical high forest	273.7
THFL	4	Tropical high forest - low stocked	127.6
Woodland	5	Woodland	12.6
Bushland	6	Non-forest: Bush	7.6
Grassland	7	Non-forest: Grassland	5.3
Wetland	8	Non-forest wetlands	1.6
Subsistence farmland	9	Non-forest: Crops	10.1
Commercial farmland	10	Non-forest: Crops	10.1
Built-up areas	11	Non-forest human settlements	4.1
Water	12		0.0
Impediment (bare soil, bare rock, and so on)	13	Non-forest: Bare soil	0.7

Average annual biomass increments

Average annual biomass increments for each LULC class were obtained from the NBS (Forest Department 2002), as indicated in Table 37.

Table 37. Annual increment (air-dry matter), as national averages

LULC class	Annual increment (t/ha)
Built-up areas	3
Bushland	1
Grassland	1
Plantations, broad-leaved	13
Subsistence farmland	1
THFL	11
THF	15
Woodland	5

Technical specification of land suitable for interventions

Different layers of information (that is, protected areas, tree cover loss between 2014 and 2018, LULC in 2017, distance to road and slope) were combined to map the areas suitable for each technical intervention (Table 38). Site-specific soil and precipitation data are provided in Annexes 3 and 4, although these were not used in the area suitability mapping. This additional information can be used in further analysis of land suitability for technical interventions (for instance, in selection of suitable species).

Natural forests (that is, THF, THFL, and woodland) in protected areas, where tree cover loss was found recently (that is, between 2014 and 2018), were considered for the 'restoration of natural forests in protected areas' intervention. Degraded natural forests outside protected areas were considered for the 'rehabilitation of degraded natural forests on private and communal land' intervention. Meanwhile the intervention package 'protection of intact natural forests in protected areas' included natural forests within protected areas with no recent tree cover loss. Intact natural forests outside protected areas were proposed under the 'protection of intact natural forests on private and communal land' intervention. Bushland and grassland with less than 15 percent slope was considered for the 'establishment of woodlots for energy and other purposes' intervention. Degraded woodlands outside protected areas within a 15 percent slope were also deemed suitable for the establishment of woodlots.

Table 38. Specifications applied for mapping technical intervention areas

Technical intervention	Protected area	Tree cover loss (2014–2018)	LULC 2017	Average distance to road	Average slope
Restoration of natural forests in protected areas	Yes	Yes	THF THFL Woodland	Any	Any
Conservation of intact natural forests in protected areas	Yes	No	THF THFL Woodland	Any	Any
Rehabilitation of degraded natural forests on private and communal land	No	Yes	THF THFL Woodland	Any	Any
Conservation of intact natural forests on private and communal land	No	No	THF THFL Woodland	Any	Any
Rehabilitation of degraded woodlands/ establishment of woodlots (<500 m from road)	No	Yes	Woodland	<500 m	<15%
Rehabilitation of degraded woodlands/ establishment of woodlots (>500 m from road)	No	Yes	Woodland	>500 m	<15%
Establishment of woodlots (<500 m from road)	No	Any	Bushland Grassland	>500 m	<15%
Establishment of woodlots (>500 m from road)	No	Any	Bushland Grassland	>500 m	<15%

Soil and rainfall data were added to allow more specific analysis of area suitability (for instance, in selection of species), the results of which are provided in Annexes 3 and 4.

Technical considerations

The following sections explore some of the technical issues that may clarify apparent discrepancies between the analyses of tree cover loss, biomass stock changes, and field observation.

Assessment of tree cover loss

This part of the study used the Global Forest Change - Version 1.6 update of the tree cover data set.[32] This data set, a collaboration between the Global Land Analysis and Discovery lab at the University of Maryland, Google, United States Geological Survey and National Aeronautics and Space Administration, measures areas of tree cover loss across all global land (except Antarctica and other Arctic islands) at approximately 30 × 30 m resolution using multispectral satellite imagery from the Landsat 5 thematic mapper (TM), the Landsat 7 enhanced thematic mapper plus (ETM+), and the Landsat 8 Operational Land Imager (OLI) sensors.

The version 1.6 update of the data set includes new loss year 2018. Relative to version 1.0 product, the method has been modified in several ways including the use of Landsat 8 OLI data for 2013 onward, the reprocessing of data from 2011 onward in measuring loss, improved training data for calibrating the loss model, improved per-sensor quality assessment models to filter input data, and improved input spectral features for building and applying the loss model. These changes led to a different and improved detection of global forest loss. However, the years preceding 2011 have not yet been reprocessed in this manner, and inconsistencies may be noticed.

Assessment of forest resources degradation

There is no global agreement on the definition of land degradation or a standardized methodology for its assessment. Tree cover loss along with LULC change was therefore used to assess forest resources degradation in this study. Vegetation cover is a response to various environmental factors including rainfall, temperature, soil, and topography, as well as factors related to human activities (Dubovyk 2017). Consequently, analysis of vegetation cover dynamics and decline is the most commonly applied remote sensing method for evaluation of land degradation. In this assessment, remote sensing-based tree cover loss dynamics were integrated with LULC information to assess land degradation and assist in the identification of technical intervention areas (as described earlier).

Uncertainty in AGB stock data

A high level of uncertainty was found in the AGB stock data set provided in the National Forest Inventory (NFI), with a margin of error exceeding 100 percent of the average values for most LULC classes, introducing the (im)possibility of negative AGB values for some classes (Table 39). The average value of AGB for each LULC class was used for the calculations of stock and stock change, disregarding the high degree of uncertainty.

Table 39. AGB stock with margin of error

LULC class	Average AGB (t/ha)	Standard deviation of AGB (t/ha)	Number of plots	Margin of error (95% confidence level)		
				%	Lower	Upper
Plantations, broad-leaved	90.6	86.8	2	146	−42.1	223.4
Plantations, coniferous	53.9	49.8	12	97	1.7	106.1
THF	273.7	196.8	2 576	1	270.9	276.5
THFL	127.6	156.5	957	6	119.9	135.4
Woodland	12.6	18.4	474	104	−0.4	25.7
Bushland	7.6	12.0	130	356	−19.5	34.7
Grassland	5.3	9.1	296	369	−14.3	24.9
Wetland	1.6	3.0	16	5 817	−91.2	94.4
Subsistence farmland	10.1	44.4	175	643	−54.9	75.1
Commercial farmland	10.1	44.4	175	643	−54.9	75.1
Built-up areas	4.1	9.1	17	2601	−101.8	109.9
Impediment (bare soil, rock, and so on)	0.7	1.3	13	15 756	−106.2	107.6

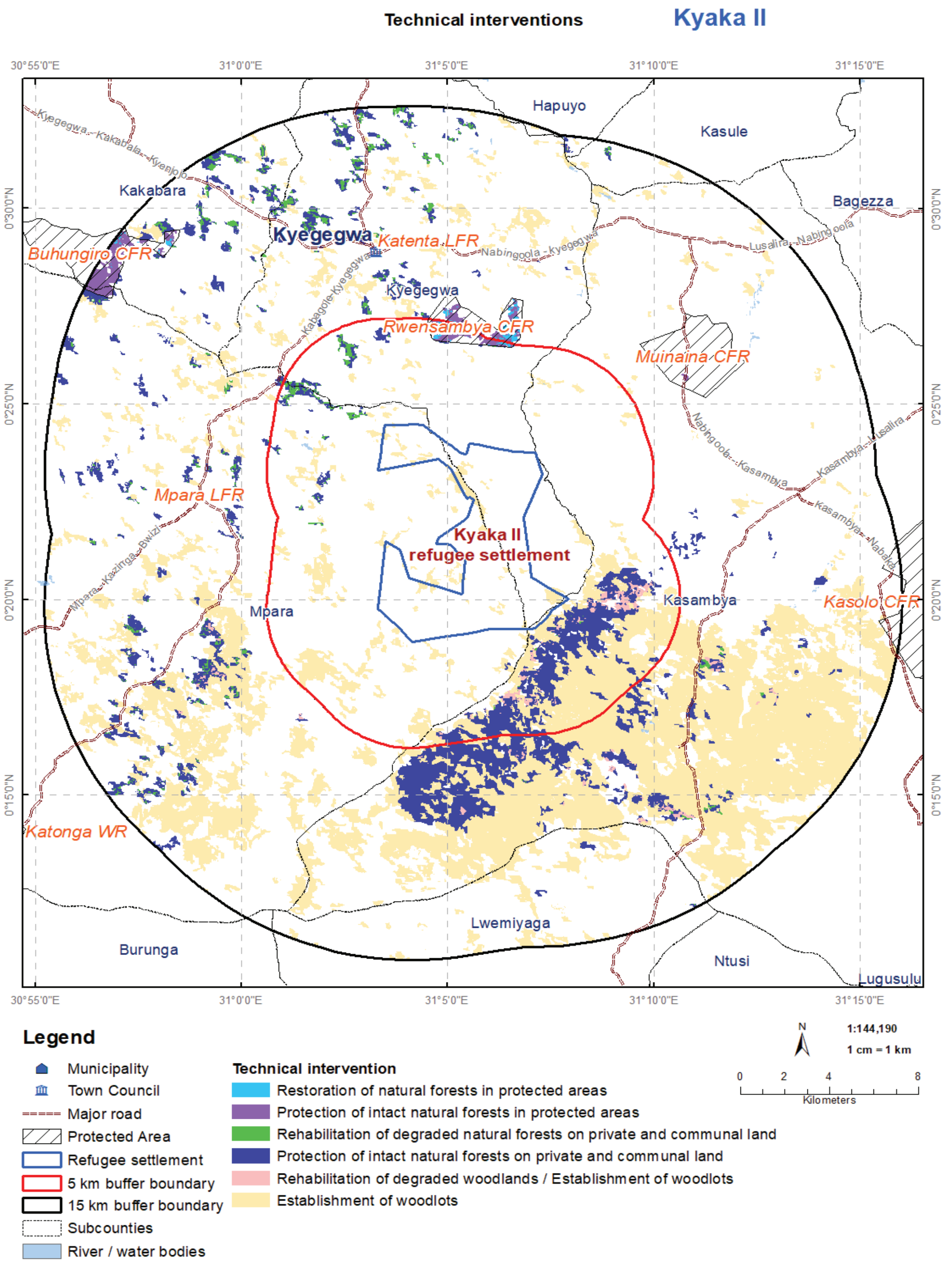
Source: NFA.

---

[32] https://developers.google.com/earth-engine/datasets/catalog/UMD_hansen_global_forest_change_2018_v1_6

ANNEX 2: POTENTIAL LAND SUITABLE FOR THE RECOMMENDED INTERVENTIONS

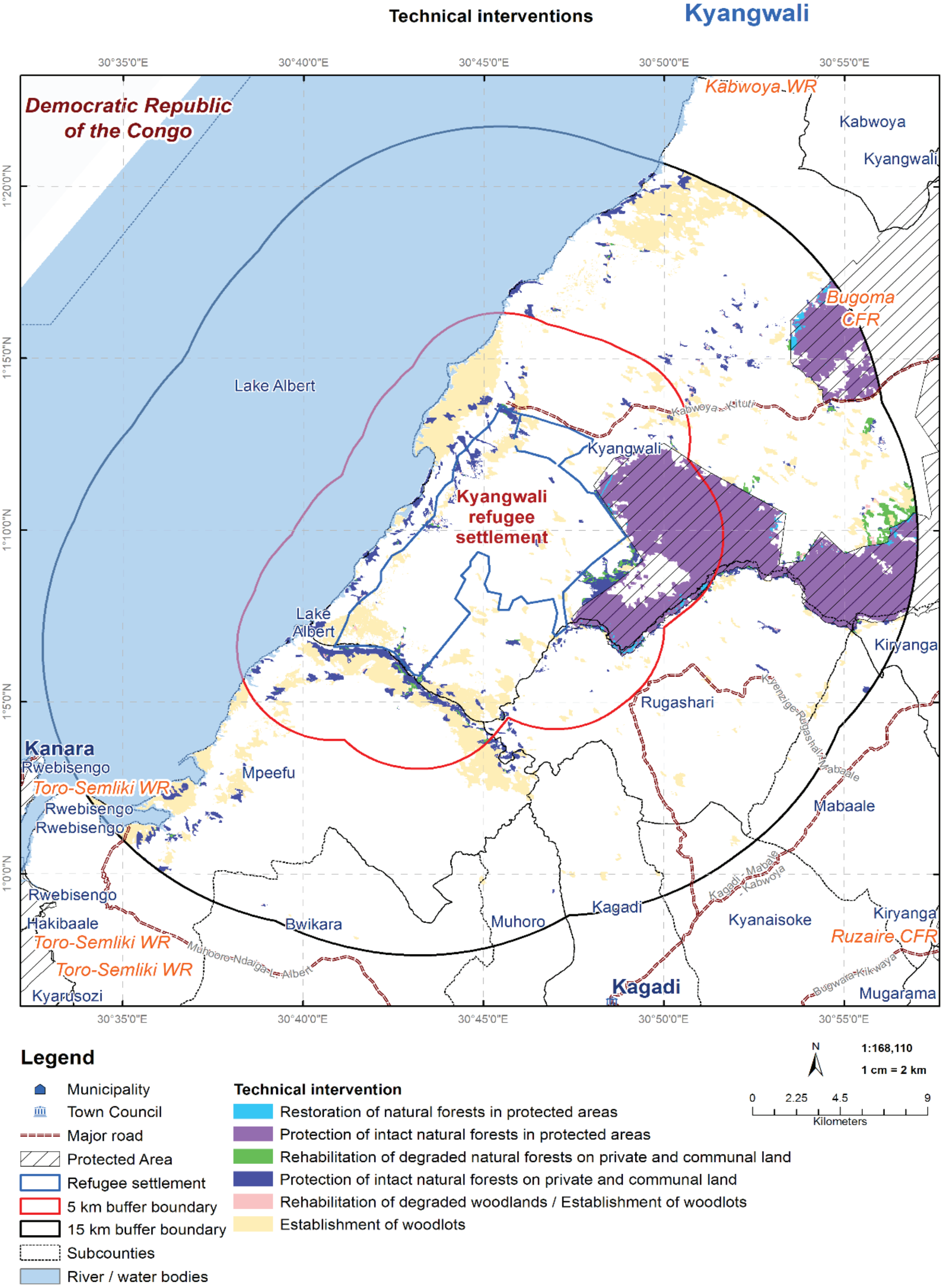
Figure 38. Potential land suitable for technical interventions in Kyaka II AoI


Technical interventions
Kyaka II
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
31°15'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
Hapuyo
Kasule
Bagezza
Kakabara
Kyegegwa
Katenta LFR
Buhungiro CFR
Kyegegwa
Rwensambya CFR
Muinaina CFR
Mpara LFR
Kyaka II refugee settlement
Kasambya
Kasolo CFR
Mpara
Katonga WR
Lwemiyaga
Burunga
Ntusi
Lugusulu
Kyegegwa - Kakabala - Kyenjojo
Nabingoola - Kyegegwa
Lusalira - Nabingoola
Kabagole-Kyegegwa
Nabingoola - Kasambya
Kasambya - Lusalira
Kasambya - Nabaka
Mpara - Kazinga - Bwizi
N
1:144,190
1 cm = 1 km
0 2 4 8
Kilometers
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
Technical intervention
Restoration of natural forests in protected areas
Protection of intact natural forests in protected areas
Rehabilitation of degraded natural forests on private and communal land
Protection of intact natural forests on private and communal land
Rehabilitation of degraded woodlands / Establishment of woodlots
Establishment of woodlots

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA.

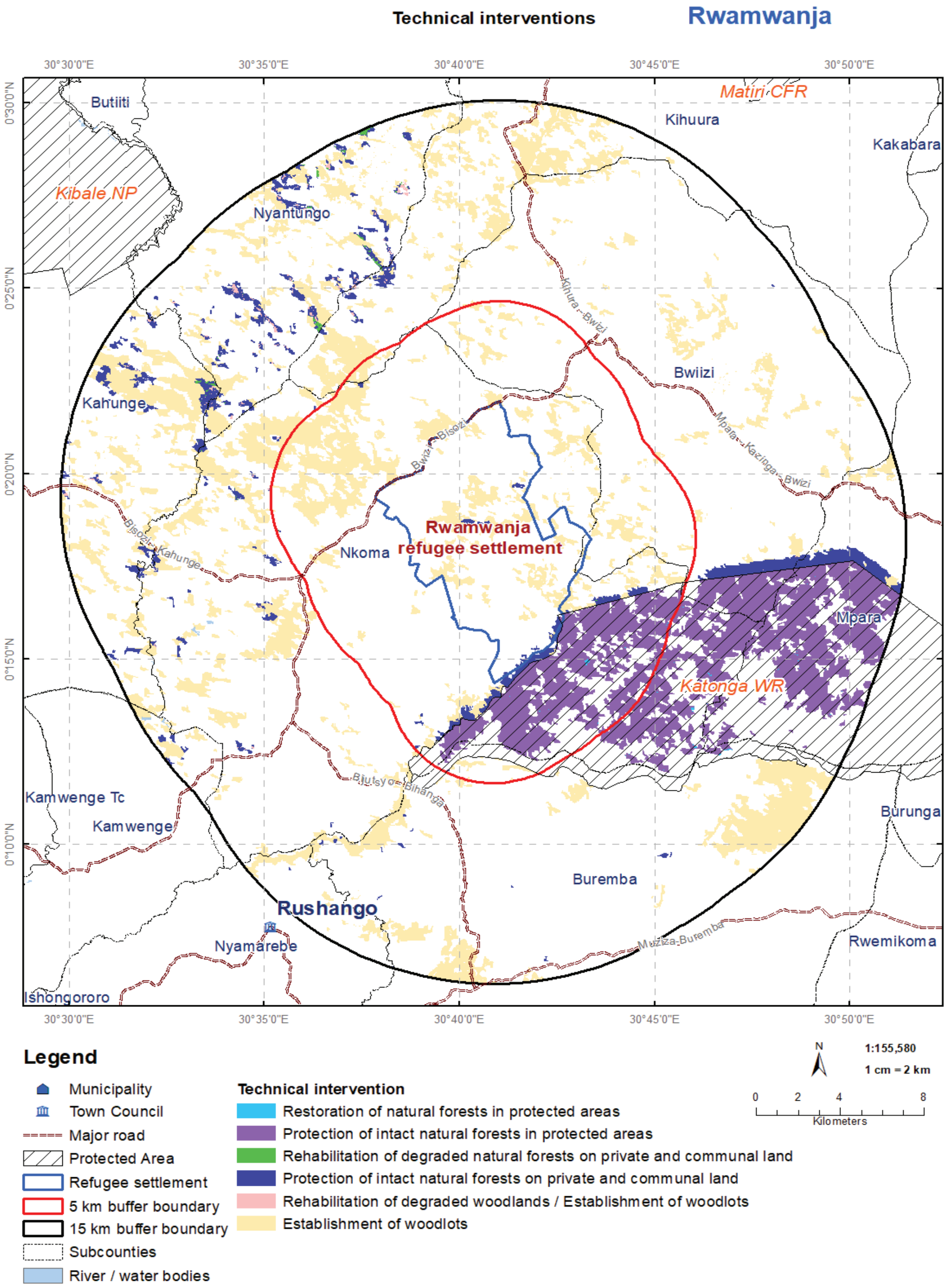
Note: In southeast of Kyaka II AoI, the potential areas for interventions cover a military reservation, but the boundary of this area is not available.

Figure 39. Potential land suitable for technical interventions in Kyangwali AoI


Technical interventions
Kyangwali
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
1°20'0"N
1°15'0"N
1°10'0"N
1°5'0"N
1°0'0"N
Democratic Republic of the Congo
Kabwoya WR
Kabwoya
Kyangwali
Bugoma CFR
Lake Albert
Kabwoya - Kituti
Kyangwali
Kyangwali refugee settlement
Lake Albert
Kiryanga
Rugashari
Kyenzige-Rugashari-Mabaale
Kanara
Rwebisengo
Toro-Semliki WR
Mpeefu
Rwebisengo
Rwebisengo
Mabaale
Kagadi - Mabaale - Kabwoya
Rwebisengo
Hakibaale
Toro-Semliki WR
Toro-Semliki WR
Muhooro-Ndaiga-L. Albert
Bwikara
Muhoro
Kagadi
Kyanaisoke
Kiryanga
Ruzaire CFR
Bugwara-Kikwaya
Kyarusozi
Kagadi
Mugarama
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
Technical intervention
Restoration of natural forests in protected areas
Protection of intact natural forests in protected areas
Rehabilitation of degraded natural forests on private and communal land
Protection of intact natural forests on private and communal land
Rehabilitation of degraded woodlands / Establishment of woodlots
Establishment of woodlots
N
1:168,110
1 cm = 2 km
0
2.25
4.5
9
Kilometers

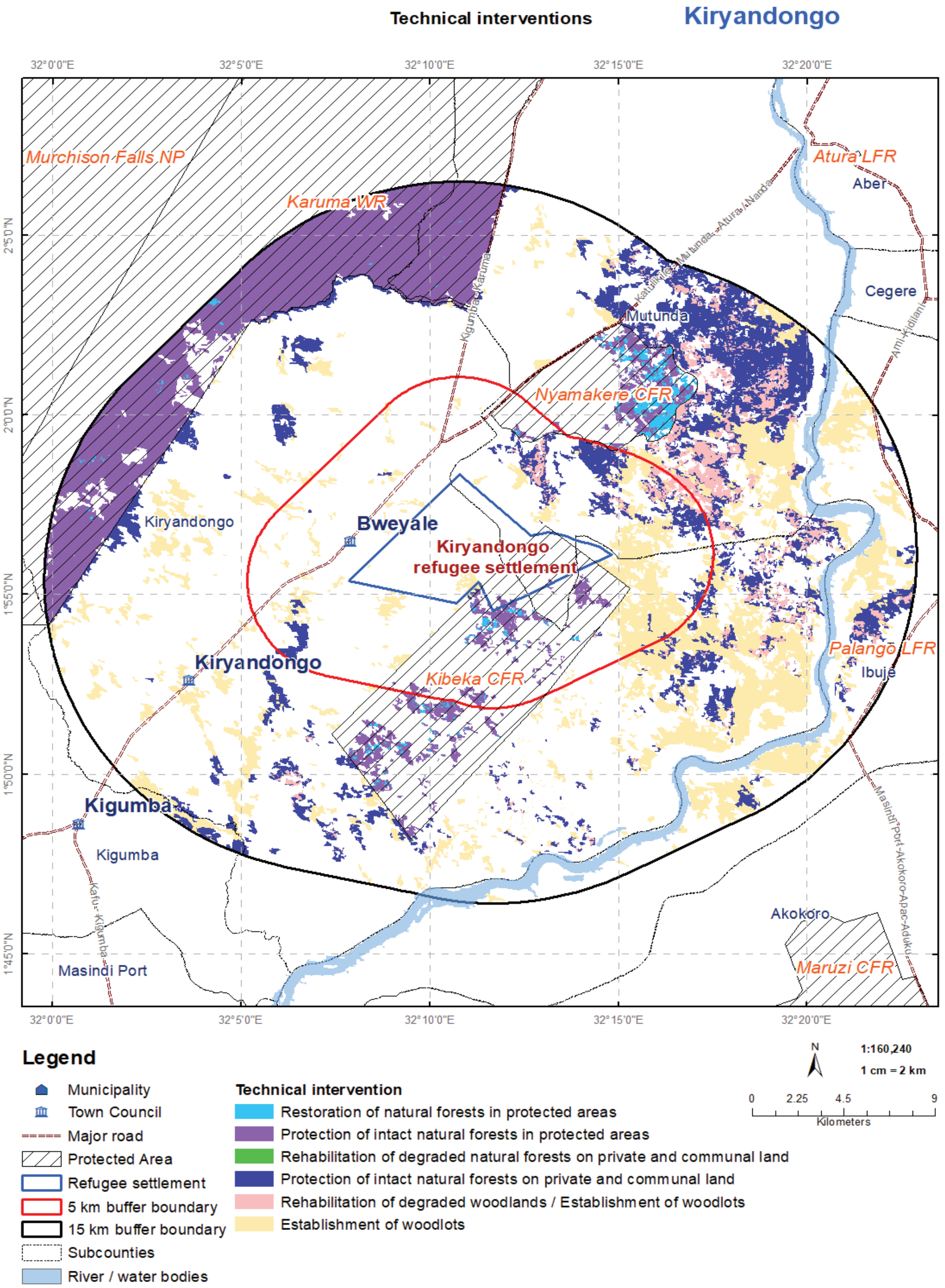
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA.

Figure 40. Potential land suitable for technical interventions in Rwamwanja AoI


Technical interventions
Rwamwanja
30°30'0"E
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
0°10'0"N
Butiiti
Matiri CFR
Kihuura
Kakabara
Kibale NP
Nyantungo
Kihura - Bwizi
Bwiizi
Kahunge
Mpara - Kazinga - Bwizi
Bwizi - Bisozi
Rwamwanja
refugee settlement
Nkoma
Bisozi - Kahunge
Mpara
Katonga WR
Bitsyo - Bihanga
Kamwenge Tc
Kamwenge
Burunga
Buremba
Rushango
Nyamarebe
Muziza-Buremba
Rwemikoma
Ishongororo
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
Technical intervention
Restoration of natural forests in protected areas
Protection of intact natural forests in protected areas
Rehabilitation of degraded natural forests on private and communal land
Protection of intact natural forests on private and communal land
Rehabilitation of degraded woodlands / Establishment of woodlots
Establishment of woodlots
N
1:155,580
1 cm = 2 km
0
2
4
8
Kilometers

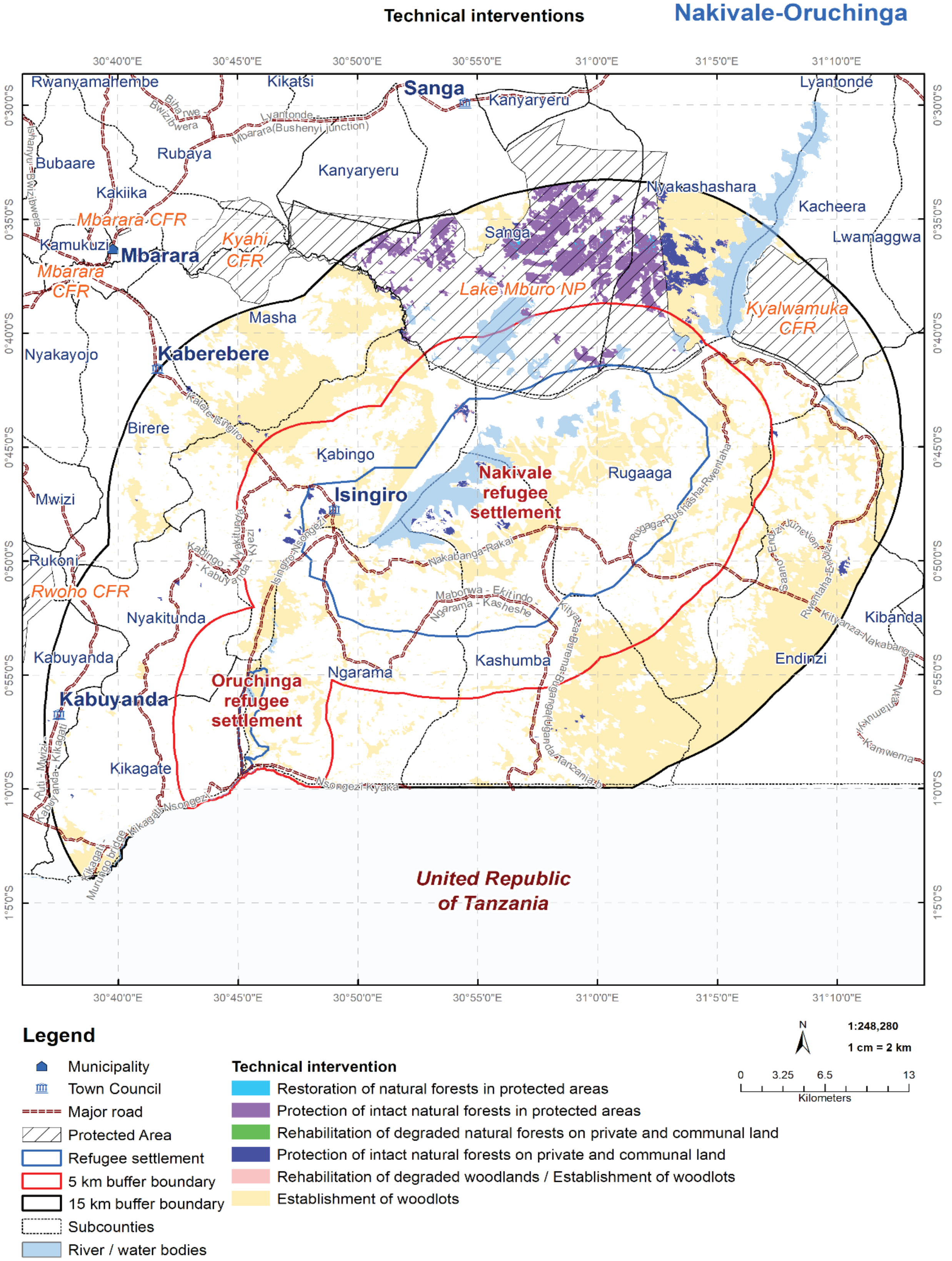
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA.

Figure 41. Potential land suitable for technical interventions in Kiryandongo AoI


Technical interventions
Kiryandongo
32°0'0"E
32°5'0"E
32°10'0"E
32°15'0"E
32°20'0"E
2°5'0"N
2°0'0"N
1°55'0"N
1°50'0"N
1°45'0"N
Murchison Falls NP
Karuma WR
Atura LFR
Aber
Cegere
Mutunda
Nyamakere CFR
Kiryandongo
Bweyale
Kiryandongo refugee settlement
Kiryandongo
Kibeka CFR
Palango LFR
Ibuje
Kigumba
Kigumba
Akokoro
Maruzi CFR
Masindi Port
Kigumba-Karuma
Katulikire-Mutunda-Atura-Nanda
Ami-Kidilani
Masindi Port-Akokoro-Apac-Aduku
Kafu-Kigumba
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
Technical intervention
Restoration of natural forests in protected areas
Protection of intact natural forests in protected areas
Rehabilitation of degraded natural forests on private and communal land
Protection of intact natural forests on private and communal land
Rehabilitation of degraded woodlands / Establishment of woodlots
Establishment of woodlots
N
1:160,240
1 cm = 2 km
0
2.25
4.5
9
Kilometers

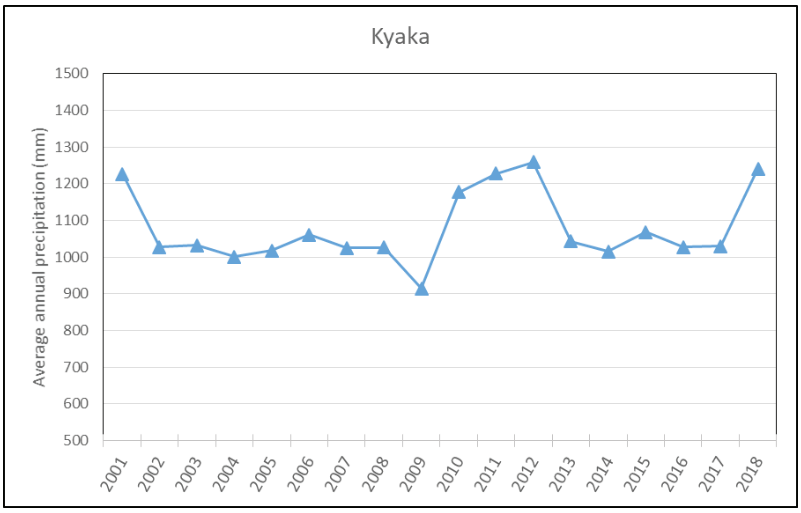
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA.

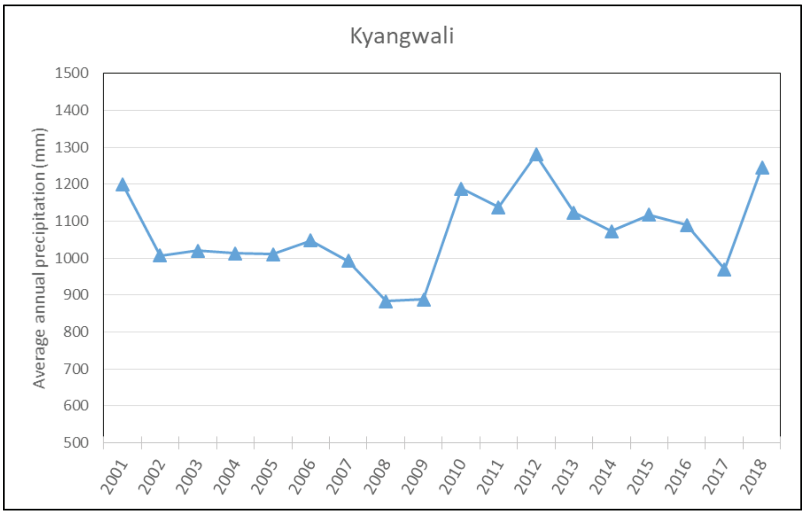
Figure 42. Potential land suitable for technical interventions in Nakivale-Oruchinga AoI

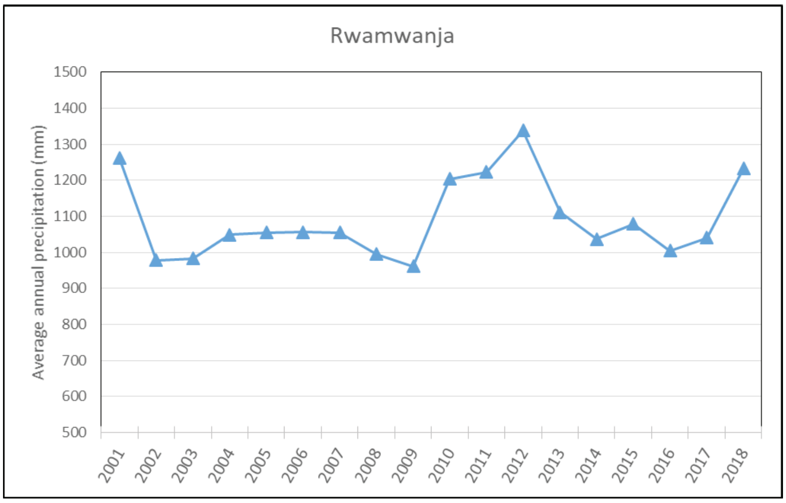

Technical interventions
Nakivale-Oruchinga
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
0°30'0"S
0°35'0"S
0°40'0"S
0°45'0"S
0°50'0"S
0°55'0"S
1°0'0"S
1°5'0"S
Rwanyamahembe
Kikatsi
Sanga
Kanyaryeru
Lyantonde
Biharwe
Bwizibwera
Lyantonde
Mbarara(Bushenyi junction)
Bubaare
Rubaya
Kanyaryeru
Kakiika
Nyakashashara
Kacheera
Mbarara CFR
Kyahi CFR
Sanga
Lwamaggwa
Kamukuzi
Mbarara
Mbarara CFR
Lake Mburo NP
Kyalwamuka CFR
Masha
Nyakayojo
Kaberebere
Kaberebere - Isingiro
Birere
Kabingo
Nakivale refugee settlement
Rugaaga
Mwizi
Isingiro
Rugaaga-Rushasha-Rwentaha
Rukoni
Kabingo - Kabuyanda - Kyezi
Isingiro-Nsongezi
Nakabanga-Rakai
Endinzi - Junction
Rwentaha-Endinzi
Rwoho CFR
Mabonwa - Ekitindo
Ngarama - Kasheshe
Kityaza
Kibanda
Nyakitunda
Kityanza-Nakabanga
Kabuyanda
Kashumba
Endinzi
Oruchinga refugee settlement
Ngarama
Kabuyanda
Kikagate
Rwemame-Bugango-Uganda-Tanzania
Kamwema
Nsongezi-Kyaka
Kikagati-Nsongezi
Kikagati-Murongo bridge
Kabuyanda - Kikagati
United Republic of Tanzania
Legend
Municipality
Town Council
Major road
Protected Area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
River / water bodies
Technical intervention
Restoration of natural forests in protected areas
Protection of intact natural forests in protected areas
Rehabilitation of degraded natural forests on private and communal land
Protection of intact natural forests on private and communal land
Rehabilitation of degraded woodlands / Establishment of woodlots
Establishment of woodlots
N
1:248,280
1 cm = 2 km
0
3.25
6.5
13
Kilometers

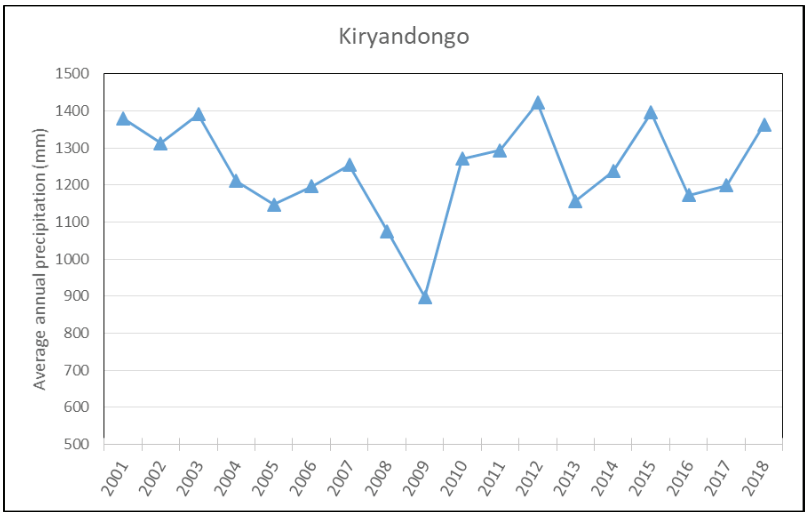
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA.

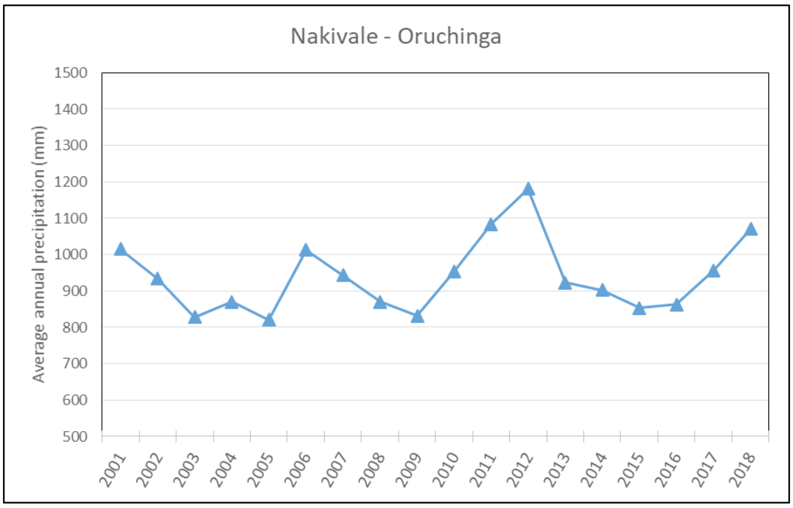
ANNEX 3: ANNUAL RAINFALL IN THE AOIS








Kiryandongo
Average annual precipitation (mm)
1500
1400
1300
1200
1100
1000
900
800
700
600
500
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018


Nakivale - Oruchinga
Average annual precipitation (mm)
1500
1400
1300
1200
1100
1000
900
800
700
600
500
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

ANNEX 4: AREAS OF POTENTIAL TECHNICAL INTERVENTIONS (IN HA) WITHIN 15 KM BY SOIL TYPE AND RAINFALL

AoI	Intervention	Rainfall[a]	Soil type											Water bodies	Total
			Acrisols	Alisols	Ferralsols	Fluvisols	Gleysols	Histosols	Leptosols	NA	Nitisols	Plinthosols	Vertisols		
Kiryandongo	Woodlots (>500 m from road)	High			4,124	946	35					84		74	5,262
		Medium			462	46						683		59	1,250
	Woodlots (<500 m from road)	High			5,392	7						131		38	5,568
		Medium			708	7						69		9	792
	Protection of intact natural forests in protected areas	High			12,250										12,250
		Medium			199										199
	Protection of intact natural forests on private & communal land	High			8,125	52	30					322		18	8,547
		Medium			357							74		12	443
	Rehab. of degraded natural forests on private & communal land	High			0										0
		Medium			1										1
	Rehab. of degraded woodlands/woodlots (>500 m from road)	High			1,037	30						78		2	1,146
		Medium			31							1		2	34
	Rehab. of degraded woodlands/woodlots (<500 m from road)	High			1,390							5			1,395
		Medium			19									1	20
	Restoration of natural forests in protected areas	High			682										682
		Medium			21										21
Kyaka II	Woodlots (>500 m from road)	Low	14												14
		Medium	4,031	12,670	76				472						17,247
	Woodlots (<500 m from road)	Low	87						1						88
		Medium	3,046	2,670	22				402						6,140
	Protection of intact natural forests in protected areas	Medium	327						265						592
	Protection of intact natural forests on private & communal land	Low	138												138
		Medium	1,145	3,634					765						5,544

AoI	Intervention	Rainfall[a]	Soil type											Water bodies	Total
			Acrisols	Alisols	Ferral-sols	Fluvisols	Gleysols	Histo-sols	Lepto-sols	NA	Nitisols	Plintho-sols	Vertisols		
	Rehab. of degraded natural forests on private & communal land	Low	98												98
		Medium	266	43					238						547
	Rehab. of degraded woodlands/woodlots (>500 m from road)	Medium	31	284											315
	Rehab. of degraded woodlands/woodlots (<500 m from road)	Medium	8	11											19
	Restoration of natural forests in protected areas	Medium	90						12						102
Kyangwali	Woodlots (>500 m from road)	Low							142					1	143
		Med.			451				400		41			0	892
	Woodlots (<500 m from road)	High			57						1				58
		Low			10				1,289					5	1,304
		Medium			2,854				2,480		39		10	51	5,433
	Protection of intact natural forests in protected areas	Medium			8,987						32				9,019
	Protection of intact natural forests on private & communal land	High			10										10
		Low							255					21	276
		Medium			1,252				811		37			31	2,130
	Rehab. of degraded natural forests on private & communal land	High			0										0
		Low							7						7
		Medium			387				18		5			1	410
	Rehab.of degraded woodlands/woodlots (>500 m from road)	High			0										0
		Low							0						0
		Medium			25				11						35
	Rehab. of degraded woodlands/woodlots (<500 m from road)	Low							4						4
		Medium			32				15		2				49
	Restoration of natural forests in protected areas	Medium			186						1				187

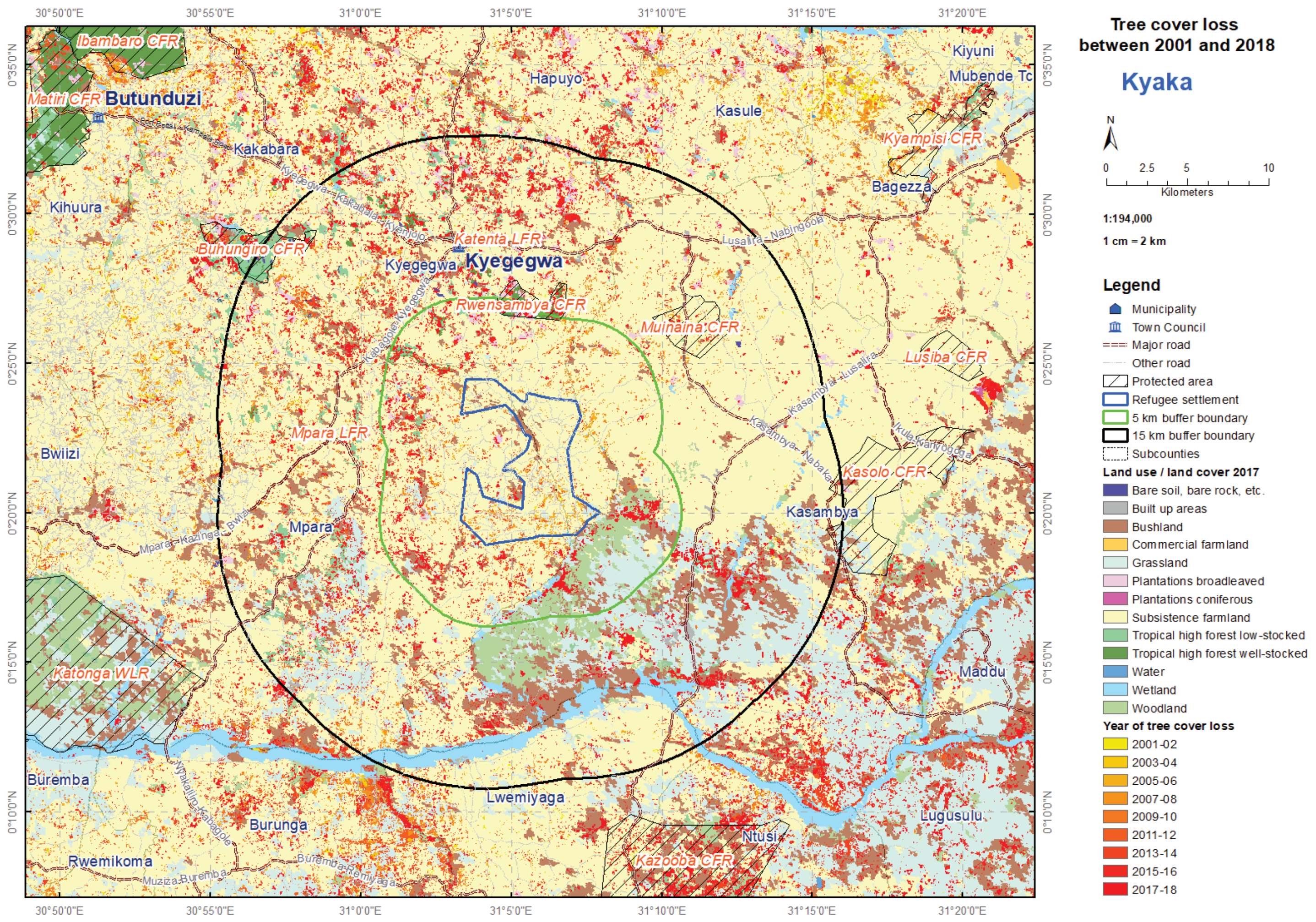
AoI	Intervention	Rainfall[a]	Soil type											Water bodies	Total
			Acrisols	Alisols	Ferral-sols	Fluvisols	Gleysols	Histo-sols	Lepto-sols	NA	Nitisols	Plintho-sols	Vertisols		
Nakivale-Oruchinga	Woodlots (>500 m from road)	Low	1,649		25,810			1,016	3,081	48	145			263	32,014
		Medium			448			94	656	0				10	1,209
	Woodlots (<500 m from road)	Low	3,842		9,661			5,360	4,951	22	837			158	24,831
		Medium			230			37	1,749	1					2,017
	Protection of intact natural forests in protected areas	Low			5,935			348	761						7,044
		Medium						7							7
	Protection of intact natural forests on private & communal land	Low	80		1,181			235	16					31	1,543
		Medium			80			7	2						90
	Rehab. of degraded natural forests on private & communal land	Low	0		1				0						2
		Medium							0						0
	Rehab. of degraded woodlands/woodlots (>500 m from road)	Low			19			35						1	55
		Medium			6			0	0						7
	Rehab. of degraded woodlands/woodlots (<500 m from road)	Low			26									6	32
	Restoration of natural forests in protected areas	Low			69			2	0						72
Rwamwanja	Woodlots (>500 m from road)	High	31												31
		Low	60		236										296
		Medium	735												735
	Woodlots (<500 m from road)	High	1,463												1,463
		Low	596		395										992
		Medium	13,314												13,314
	Protection of intact natural forests in protected areas	Medium	8,888												8,888

AoI	Intervention	Rainfall[a]	Soil type											Water bodies	Total
			Acrisols	Alisols	Ferral-sols	Fluvisols	Gleysols	Histo-sols	Lepto-sols	NA	Nitisols	Plintho-sols	Vertisols		
Rwamwanja	Protection of intact natural forests on private & communal land	High	227												227
		Low	45		4										48
		Medium	1,961												1,961
	Rehab. of degraded natural forests on private & communal land	High	24												24
		Medium	40												40
	Rehab. of degraded woodlands/woodlots (>500 m from road)	High	4												4
		Low	0												0
		Medium	5												5
	Rehab. of degraded woodlands/woodlots (<500 m from road)	High	34												34
		Low	2												2
		Medium	83												83
	Restoration of natural forests in protected areas	Medium	19												19
		Total	**42,384**	**19,312**	**93,249**	**1,086**	**64**	**7,142**	**18,804**	**72**	**1,139**	**1,447**	**10**	**792**	**185,501**

Note: a. Low rainfall = 700–1,000 mm per year; medium = 1,000–1,200 mm per year; high = >1,200 mm per year.

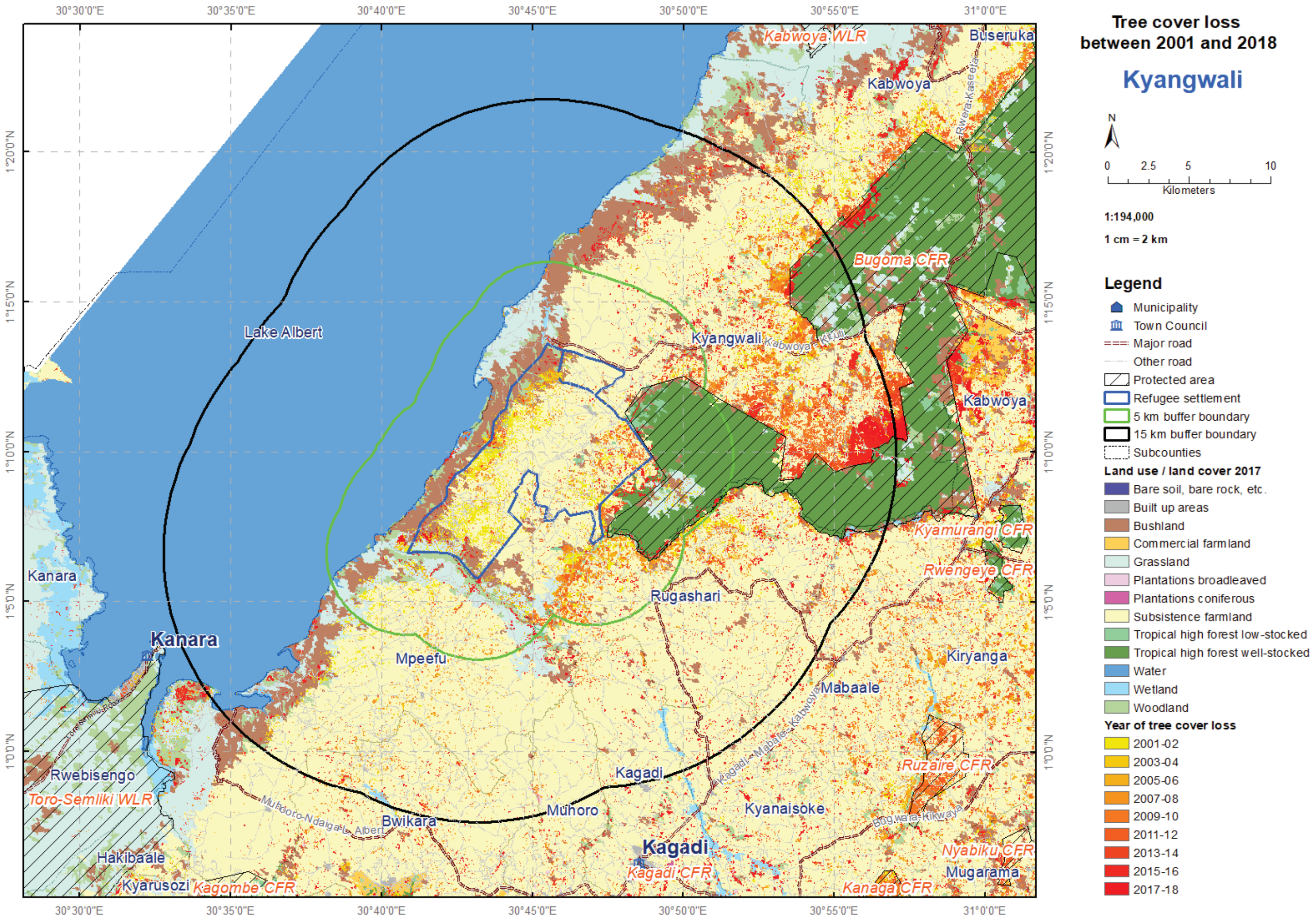
ANNEX 5: ANNUAL TREE COVER LOSS FROM 2001 TO 2018

Figure 43. Annual tree cover loss from 2001 to 2018 in Kyaka II


Tree cover loss between 2001 and 2018
Kyaka
N
0 2.5 5 10
Kilometers
1:194,000
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Other road
Protected area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Land use / land cover 2017
Bare soil, bare rock, etc.
Built up areas
Bushland
Commercial farmland
Grassland
Plantations broadleaved
Plantations coniferous
Subsistence farmland
Tropical high forest low-stocked
Tropical high forest well-stocked
Water
Wetland
Woodland
Year of tree cover loss
2001-02
2003-04
2005-06
2007-08
2009-10
2011-12
2013-14
2015-16
2017-18
30°50'0"E
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
31°15'0"E
31°20'0"E
0°35'0"N
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
0°10'0"N
Ibambaro CFR
Matiri CFR
Butunduzi
Kakabara
Kihuura
Buhungiro CFR
Katenta LFR
Kyegegwa
Kyegegwa
Rwensambya CFR
Hapuyo
Kasule
Kiyuni
Mubende Tc
Kyampisi CFR
Bagezza
Muinaina CFR
Lusiba CFR
Kasolo CFR
Kasambya
Mpara LFR
Mpara
Bwiizi
Katonga WLR
Buremba
Burunga
Rwemikoma
Lwemiyaga
Kazooba CFR
Ntusi
Lugusulu
Maddu

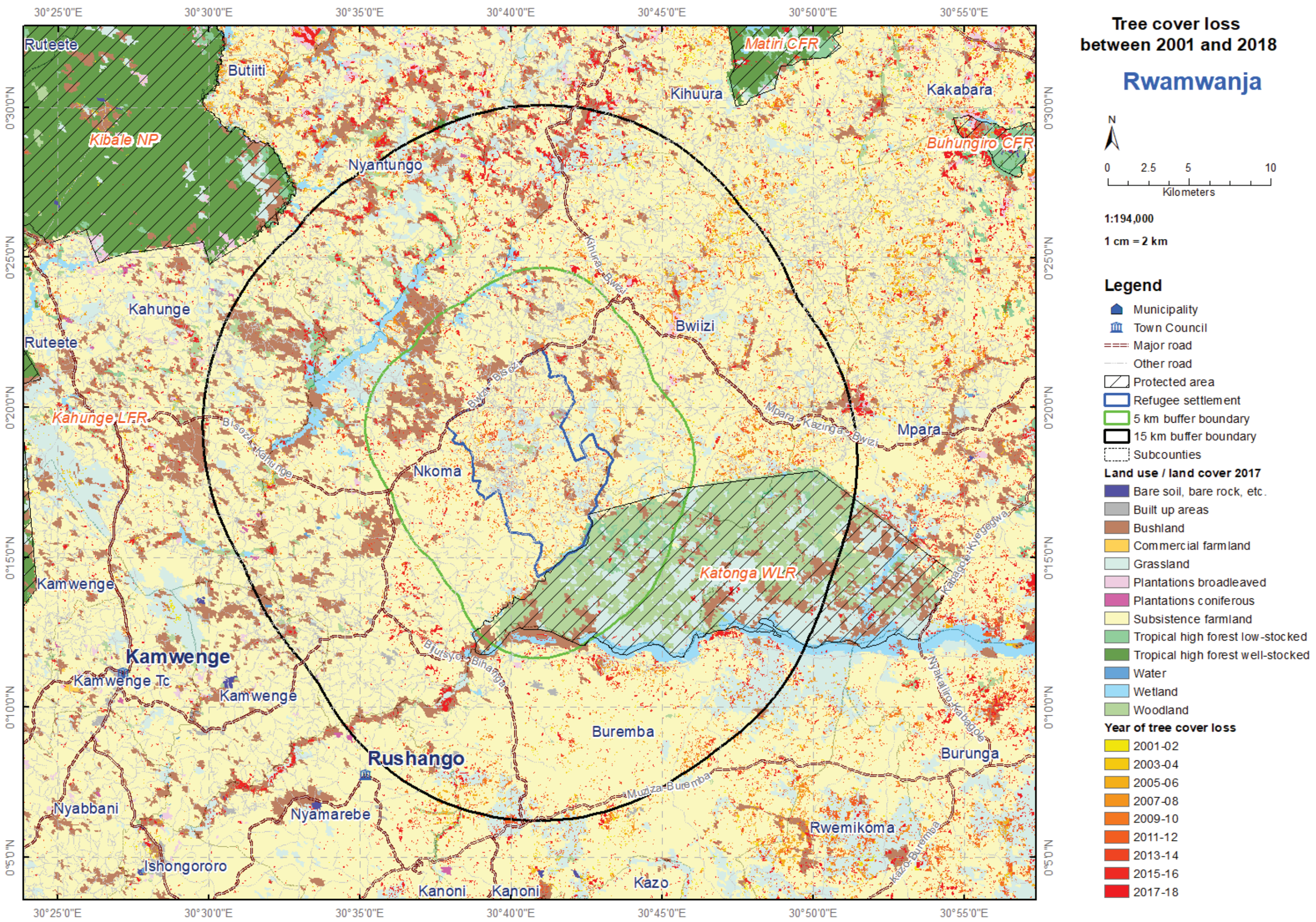
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA; tree cover loss: Hansen et al. 2013.

Figure 44. Annual tree cover loss from 2001 to 2018 in Kyangwali


Tree cover loss
between 2001 and 2018
Kyangwali
N
0
2.5
5
10
Kilometers
1:194,000
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Other road
Protected area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Land use / land cover 2017
Bare soil, bare rock, etc.
Built up areas
Bushland
Commercial farmland
Grassland
Plantations broadleaved
Plantations coniferous
Subsistence farmland
Tropical high forest low-stocked
Tropical high forest well-stocked
Water
Wetland
Woodland
Year of tree cover loss
2001-02
2003-04
2005-06
2007-08
2009-10
2011-12
2013-14
2015-16
2017-18
30°30'0"E
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
31°0'0"E
1°20'0"N
1°15'0"N
1°10'0"N
1°5'0"N
1°0'0"N
Kabwoya WLR
Buseruka
Kabwoya
Bugoma CFR
Lake Albert
Kyangwali
Kabwoya
Kyamurangi CFR
Rwengeye CFR
Kanara
Kanara
Rugashari
Mpeefu
Kiryanga
Mabaale
Rwebisengo
Toro-Semliki WLR
Ruzaire CFR
Kagadi
Muhoro
Bwikara
Kyanaisoke
Kagadi
Kagadi CFR
Nyabiku CFR
Mugarama
Hakibaale
Kyarusozi
Kagombe CFR
Kanaga CFR

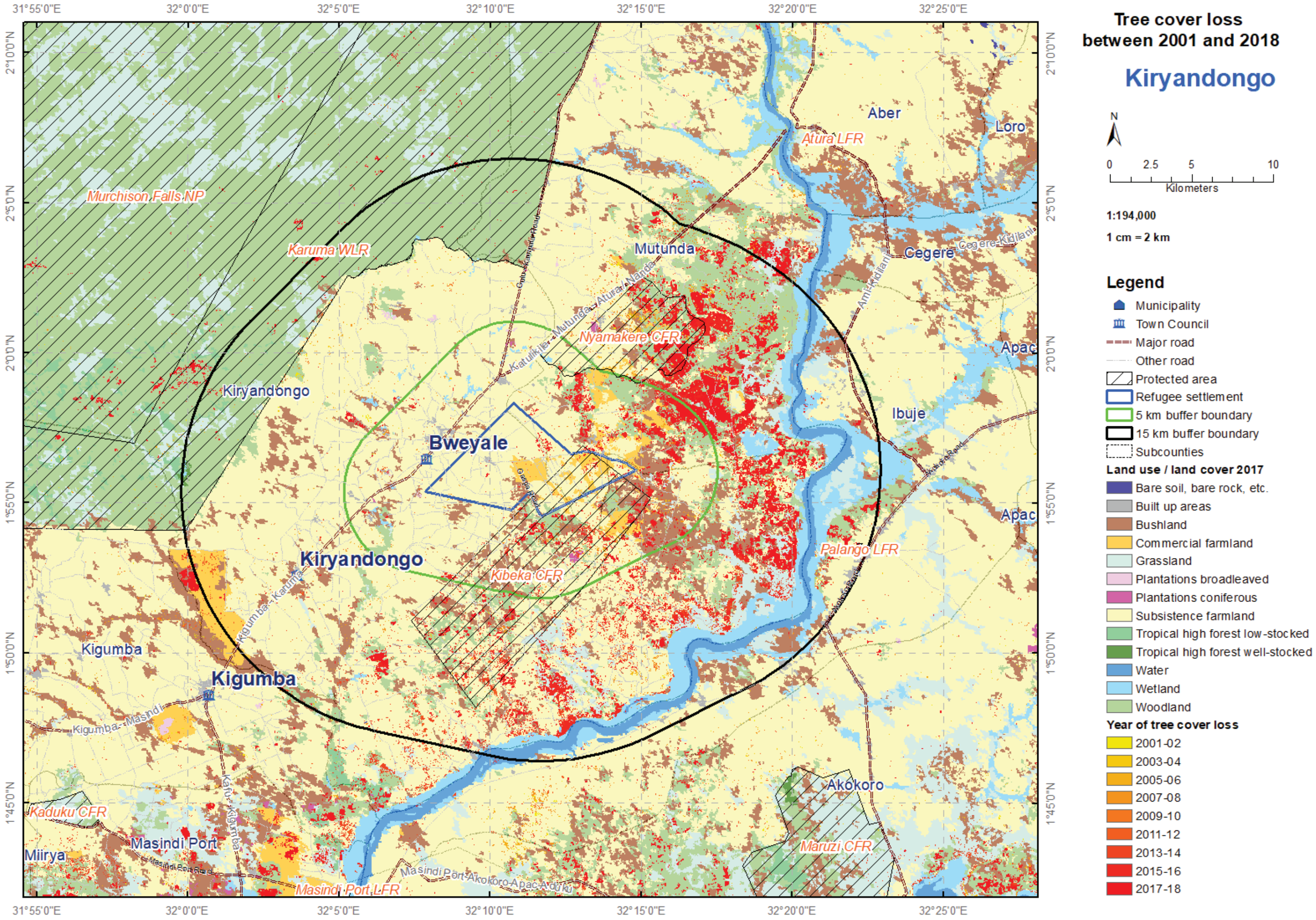
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA; tree cover loss: Hansen et al. 2013.

Figure 45. Annual tree cover loss from 2000 to 2018 in Rwamwanja


Tree cover loss between 2001 and 2018
Rwamwanja
N
0
2.5
5
10
Kilometers
1:194,000
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Other road
Protected area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Land use / land cover 2017
Bare soil, bare rock, etc.
Built up areas
Bushland
Commercial farmland
Grassland
Plantations broadleaved
Plantations coniferous
Subsistence farmland
Tropical high forest low-stocked
Tropical high forest well-stocked
Water
Wetland
Woodland
Year of tree cover loss
2001-02
2003-04
2005-06
2007-08
2009-10
2011-12
2013-14
2015-16
2017-18
30°25'0"E
30°30'0"E
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
0°30'0"N
0°25'0"N
0°20'0"N
0°15'0"N
0°10'0"N
0°5'0"N
Ruteete
Butiiti
Kibale NP
Matiri CFR
Kihuura
Kakabara
Buhungiro CFR
Nyantungo
Kahunge
Ruteete
Bwiizi
Kahunge LFR
Nkoma
Mpara
Katonga WLR
Kamwenge
Kamwenge
Kamwenge Tc
Kamwenge
Buremba
Rushango
Burunga
Nyabbani
Nyamarebe
Rwemikoma
Ishongororo
Kanoni
Kanoni
Kazo
Kihura-Bwizi
Mpara-Kazinga-Bwizi
Bwizi-Bisozi
Bisozi-Kahunge
Biturso-Binanga
Kabagole-Kyegegwa
Nyakatiiro-Kabagole
Muzza-Buremba
Kazo-Buremba

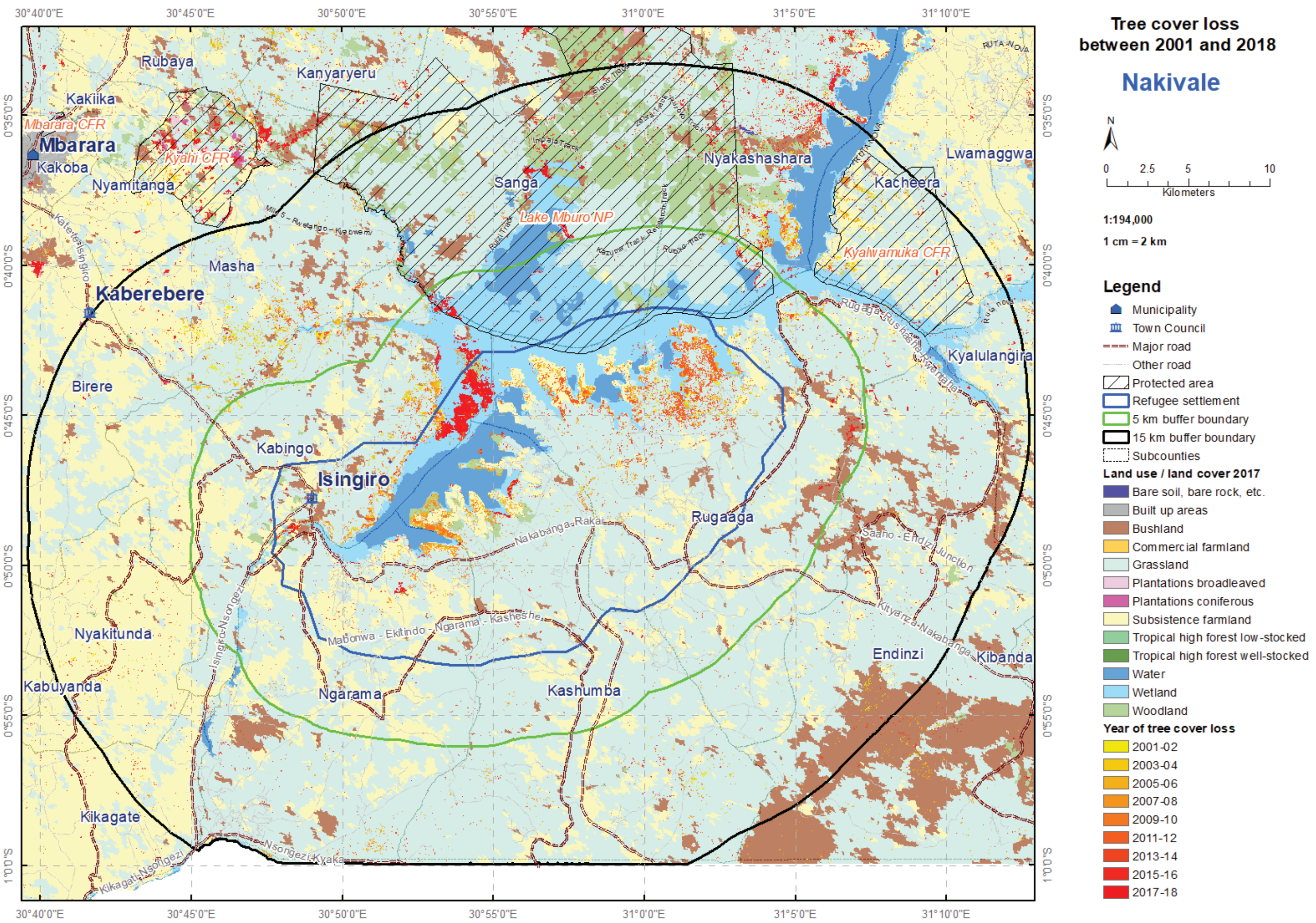
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA; tree cover loss: Hansen et al. 2013.

Figure 46. Annual tree cover loss from 2001 to 2018 in Kiryandongo


Tree cover loss between 2001 and 2018
Kiryandongo
N
0
2.5
5
10
Kilometers
1:194,000
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Other road
Protected area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Land use / land cover 2017
Bare soil, bare rock, etc.
Built up areas
Bushland
Commercial farmland
Grassland
Plantations broadleaved
Plantations coniferous
Subsistence farmland
Tropical high forest low-stocked
Tropical high forest well-stocked
Water
Wetland
Woodland
Year of tree cover loss
2001-02
2003-04
2005-06
2007-08
2009-10
2011-12
2013-14
2015-16
2017-18
31°55'0"E
32°0'0"E
32°5'0"E
32°10'0"E
32°15'0"E
32°20'0"E
32°25'0"E
2°10'0"N
2°5'0"N
2°0'0"N
1°55'0"N
1°50'0"N
1°45'0"N
Murchison Falls NP
Karuma WLR
Aber
Atura LFR
Loro
Mutunda
Cegere
Nyamakere CFR
Kiryandongo
Apac
Ibuje
Bweyale
Kiryandongo
Palango LFR
Kibeka CFR
Kigumba
Kigumba
Akokoro
Kaduku CFR
Masindi Port
Miirya
Maruzi CFR
Masindi Port LFR

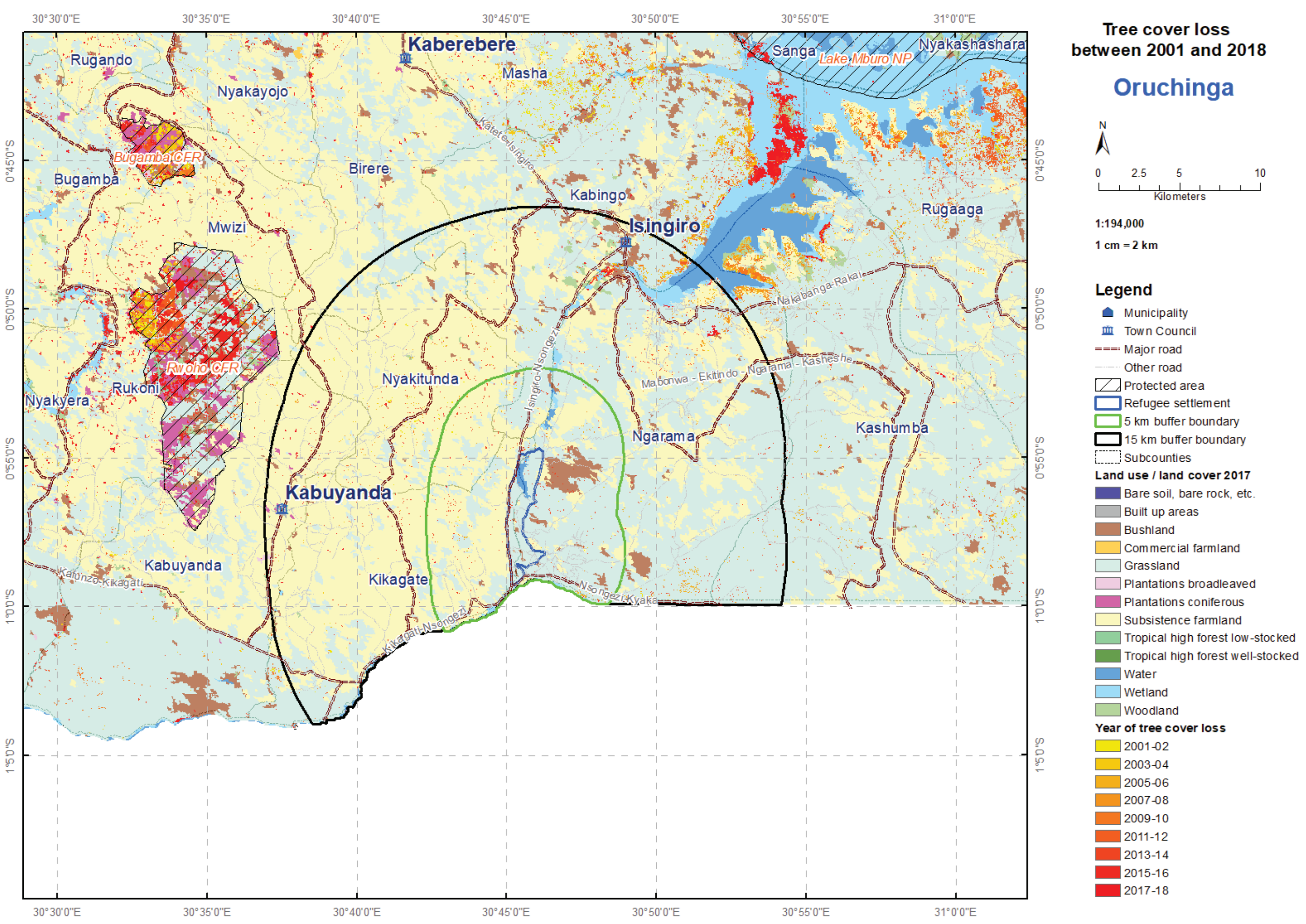
Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA; tree cover loss: Hansen et al. 2013.

Figure 47. Annual tree cover loss from 2001 to 2018 in Nakivale


Tree cover loss between 2001 and 2018
Nakivale
N
0
2.5
5
10
Kilometers
1:194,000
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Other road
Protected area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Land use / land cover 2017
Bare soil, bare rock, etc.
Built up areas
Bushland
Commercial farmland
Grassland
Plantations broadleaved
Plantations coniferous
Subsistence farmland
Tropical high forest low-stocked
Tropical high forest well-stocked
Water
Wetland
Woodland
Year of tree cover loss
2001-02
2003-04
2005-06
2007-08
2009-10
2011-12
2013-14
2015-16
2017-18
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
31°0'0"E
31°5'0"E
31°10'0"E
0°35'0"S
0°40'0"S
0°45'0"S
0°50'0"S
0°55'0"S
1°0'0"S
Rubaya
Kanyaryeru
Kakiika
Mbarara CFR
Mbarara
Kakoba
Kyahi CFR
Nyamitanga
Sanga
Nyakashashara
Lwamaggwa
Kacheera
Lake Mburo NP
Kyalwamuka CFR
Masha
Kaberebere
Kyalulangira
Birere
Kabingo
Isingiro
Rugaaga
Nakabanga-Rakai
Saano - Endizi Junction
Nyakitunda
Mabonwa - Ekitindo - Ngarama - Kashashe
Kityanza-Nakabanga
Endinzi
Kibanda
Kabuyanda
Ngarama
Kashumba
Kikagate
Isingiro-Nsongezi
Nsongezi-Kyaka
Kikagati-Nsongezi
Katete-Isingiro
Rugaaga-Rushasha-Kyalulangira
Ruta Noya

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA; tree cover loss: Hansen et al. 2013.

Figure 48. Annual tree cover loss from 2001 to 2018 in Oruchinga


30°30'0"E
30°35'0"E
30°40'0"E
30°45'0"E
30°50'0"E
30°55'0"E
31°0'0"E
0°45'0"S
0°50'0"S
0°55'0"S
1°0'0"S
1°5'0"S
Kaberebere
Rugando
Masha
Nyakayojo
Sanga
Lake Mburo NP
Nyakashashara
Bugamba CFR
Bugamba
Birere
Kabingo
Isingiro
Rugaaga
Mwizi
Katete-Isingiro
Nakabanga-Rakai
Rwoho CFR
Rukoni
Nyakyera
Nyakitunda
Mabonwa - Ekitindo - Ngarama - Kasheshe
Isingiro-Nsongezi
Ngarama
Kashumba
Kabuyanda
Kikagate
Kafunzo-Kikagati
Kikagati-Nsongezi
Nsongezi-Kyaka
Tree cover loss
between 2001 and 2018
Oruchinga
N
0
2.5
5
10
Kilometers
1:194,000
1 cm = 2 km
Legend
Municipality
Town Council
Major road
Other road
Protected area
Refugee settlement
5 km buffer boundary
15 km buffer boundary
Subcounties
Land use / land cover 2017
Bare soil, bare rock, etc.
Built up areas
Bushland
Commercial farmland
Grassland
Plantations broadleaved
Plantations coniferous
Subsistence farmland
Tropical high forest low-stocked
Tropical high forest well-stocked
Water
Wetland
Woodland
Year of tree cover loss
2001-02
2003-04
2005-06
2007-08
2009-10
2011-12
2013-14
2015-16
2017-18

Sources: Towns: UBOS 2016; subcounties and roads: Arc Online; protected areas: NFA and UWA; refugee settlement: UNHCR; LULC: NFA; tree cover loss: Hansen et al. 2013.

Food and Agriculture
Organization of the
United Nations

WORLD BANK GROUP

State and
Peacebuilding
Fund

CA7832EN/1/02.20